

## **Appendix 24**

### **Air Quality**

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## **Appendix 24A Methodology for Air Quality and GHG Emissions Calculations**

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## **APPENDIX 24A.**

# **Methodology for Air Quality and GHG Emissions Calculations**

All project alternatives (except for the No Project/No Action Alternative) would involve the construction and operation of surface water storage reservoirs, and associated water intakes, conveyance facilities (canals, pipelines, tunnels, and pumping plants), service roads, dams, buildings, recreation facilities, and hydroelectric generation facilities.

### **24A.1 Construction Emissions**

Construction would involve land clearing and grubbing, earthmoving for reservoir development, cut and fill operations, trenching, soil compaction, and grading. Construction-related activities would require extensive use of construction equipment, such as excavators, graders, scrapers, bulldozers, backhoes, and concrete mixing and pumping trucks. Haul trucks would be used to move borrow and/or spoils and other materials.

Construction-related emissions would arise from a variety of activities, including: (1) exhaust from fuel combustion in construction equipment, trucks, and worker vehicles; (2) generation of fugitive dust during land disturbance by equipment used for grading, excavation, road building, and other earth-moving activities; (3) fugitive dust from travel by construction equipment, haul trucks, and worker vehicles on paved and unpaved surfaces; and (4) fugitive dust from establishing quarries and borrow sites and from storing and handling materials.

#### **24A.1.1 Estimation of Exhaust Emissions from Operation of Construction Equipment**

Lists of the types and numbers of construction equipment and number of days required for construction of each project feature for Alternative C were developed based on information provided by URS in a spreadsheet titled Equipment Spreadsheet 6-29-2011.xlsx (URS, 2011a). For the emission calculations, the term ‘equipment-days’ was used to represent the result of multiplying the number of each type of equipment by the number of days that equipment would be in use. For example, if three bulldozers would operate for 30 days, this would represent 90 equipment-days for bulldozers. Equipment was assumed to operate 10 hours per day, except for the electric tunnel boring machine which was assumed to operate 24 hours per day. Additional information was provided by URS on May 8, 2012 regarding estimated equipment use and manpower for periodic Funks Reservoir sediment removal (URS, 2012).

Equipment-specific emission factors were obtained by first assigning each type of equipment to the most similar equipment type from the OFFROAD model (ARB, 2007). Typical load factors, horsepower ratings, and emission factors for the criteria pollutants (NO<sub>x</sub>, PM<sub>10</sub>, ROG, SO<sub>x</sub>, CO, PM<sub>2.5</sub>) were derived from the CalEEMod User’s Guide, Appendix D (SCAQMD, 2011). The CO<sub>2</sub> emission factors for equipment use were taken from Appendix I of the URBEMIS2007 for Windows Users Guide (SCAQMD, 2007). Emissions for the construction years 2013 through 2021 were estimated using statewide-average emission factors for the year 2013. Emissions from concrete trucks, fuel trucks, and dump trucks operated within the construction area (i.e., not driving to the construction site from an offsite location) were estimated using off-highway truck emission factors. For example, this would include concrete trucks making trips from an on-site concrete batch plant to the pour location.

Equipment-specific hours of use were multiplied by equipment-specific emission factors to calculate total equipment emissions for construction of each project feature. Total emissions for each project feature were estimated by summing the results of the equipment emissions.

Information on the dates of construction start and finish, and the duration of construction for each project feature, were obtained from the Concept Schedule for NODOS-Sites Reservoir provided by URS (URS, 2011b). Average daily emissions rates, in units of pounds per day (lbs/day), for construction of each project feature were estimated by dividing the total emissions for construction of each project feature by the construction duration in days for that feature. Based on the dates of construction start and finish, the years when construction of each feature would occur were identified. The average daily emission rates (in lbs/day) estimated for each of the project features that would be constructed in each identified construction year were summed to provide the average daily construction emission rates for the construction year, for Alternative C.

To estimate emissions for the other alternatives, the following assumptions were used. The emissions estimates for construction of Alternatives B and C were assumed to be the same, because there would be only minor differences between the two alternatives with regard to overall construction requirements. For example, Alternative B does not include construction of the transmission line from the PG&E line to the Sacramento River and there are no Delevan pipeline intake facilities, only a pipeline discharge facility. However, these differences in required construction activities are not expected to result in substantial differences in the estimated construction emissions.

To estimate emissions for Alternative A, URS engineering staff recommended an assumption that equipment use was directly related to material volumes for dam construction (URS, 2011a). For Alternative A, the values provided by URS for equipment-days for construction of the reservoir and dams under Alternative C were multiplied by a factor of 0.53, because the total volume of materials estimated for the smaller reservoir and dams is approximately 53 percent of that for the larger reservoir. One exception is the factor used by DWR in estimates of concrete use and associated GHG emissions for the alternatives. Equipment use for construction of the other project features was assumed to be the same for Alternatives A, B, and C.

As summarized in emission calculation sheets, the average daily construction emission rates for each construction year in lbs/day for each of the alternatives have been compared to the TCAPCD thresholds of significance of 137 lb/day for NO<sub>x</sub>, ROG, and PM<sub>10</sub> to evaluate the significance of the alternative's impacts on air quality.

### **24A.1.2 Estimation of Exhaust Emissions from On-road Vehicles**

Emissions from on-road vehicles were estimated by multiplying the number of vehicle roundtrips by the number of roundtrips miles by an emission factor (in units of pounds per mile). Exhaust emissions were estimated using EMFAC2007 emission factors for the year 2013 (ARB, 2006). It was assumed highway trucks would travel an average roundtrip distance of 70 miles and construction workers would commute an average roundtrip distance of 80 miles.

### **24A.1.3 Estimation of Fugitive Dust Emissions**

Fugitive dust would result from vehicle travel on unpaved and paved roads and soil disturbing activities, such as grading, and concrete batching. Fugitive dust from unpaved road travel, soil disturbing activities, and concrete batching would occur onsite, while fugitive dust from vehicle travel on paved roads would

occur offsite. It was assumed that water trucks, dump trucks, and delivery trucks would travel an average distance of two miles per day on unpaved roads.

Fugitive dust emissions from vehicle travel on unpaved and paved roads were estimated using EPA-approved emission factors and methodology published in AP-42 (EPA, 2011a and EPA, 2006). It was assumed that travel on unpaved roads would be limited to a speed of 15 miles per hour (mph) as a project best management practice (BMP). Therefore, the unmitigated unpaved road emissions were reduced by 44 percent, the control efficiency from the URBEMIS2007 model, to account for the reduced vehicle speed.

Fugitive dust emissions from soil disturbance (for example, grading activities) were estimated based on the average emission factor of 10 lbs per acre per day in URBEMIS2007. It was assumed that areas with soil disturbance would be watered daily as a project BMP. Therefore, use of the average emission factor for disturbed areas (10 lbs per acres per day) reflects a reduction of emissions by 50 percent when compared to the default disturbed area emission factor in URBEMIS2007 (20 lbs per acres per day).

Fugitive dust emissions from concrete batch plant operations were estimated using EPA approved emission factors published in AP-42 (EPA, 2006).

#### **24A.1.4 Approach and Methodology for Concrete Estimates and GHG Emissions Estimates**

GHG emissions from concrete used in each of the alternatives were calculated by DWR using the volume of concrete estimated to be used in the construction (provided by URS). The volume of concrete used in each alternative was multiplied by a factor of 400 lbs of CO<sub>2</sub>e per cubic yard (cy) of concrete. This factor is derived from a study by the Portland Cement Association (Michael A. Nisbet, Medgar L. Marceau, and Martha G. VanGeem, “Environmental Life Cycle Inventory of Portland Cement Concrete”, PCA R&D Serial No. 2137a, a report on Concrete: Sustainability and Life Cycle, PCA CD033, 2003, <http://www.cement.org/>) which found that CO<sub>2</sub> emissions from concrete range from 190 lbs/cy to 500 lbs/cy depending on the cement content of the concrete. Based on the types of concrete used for this project, DWR has determined that a factor of 400 lbs CO<sub>2</sub>e/cy would be used to estimate GHG emissions from concrete used on the project.

Concrete quantities for Alternatives B & C were estimated using the equipment estimates spreadsheet developed by URS. To estimate the concrete quantities associated with Alternative A, the ratio of concrete used to construct only the dams was compared between Alternative A and Alternatives B & C. Total cubic yards of concrete including concrete for the grout caps, slurry walls, and sacks of cement (5 sacks cement / cy of concrete for Type III cement) was summed for Sites Dam, Golden Gate Dam, and associated Saddle Dams for both Alternative A and Alternatives B & C. For Alternative A, the sum of the values provided by URS for concrete use for construction of the dams under Alternatives B & C was multiplied by a factor of 0.58, because the total volume of concrete estimated for the dams for the smaller reservoir under Alternative A is approximately 58 percent of that for the dams for the larger reservoir under Alternatives B & C.

### **24A.2 Operations and Maintenance Emissions**

Emissions associated with operations and maintenance of the alternatives depends on the size and type of facility, the number of employees and types of equipment, the increased traffic on the local and regional roadway network (including additional haul trucks and workers), and the level of operations activities. Emissions similar to those expected during construction, but at lower levels, would likely result from

operations and maintenance of projects. For example, operational sources of fugitive dust would primarily be maintenance equipment and truck movement over paved and unpaved surfaces. Stationary sources, such as electrical generators, would be subject to permitting requirements to limit emissions. Required mitigation and operating conditions would be reflected in needed permits and approvals for the project.

To estimate emissions from operations and maintenance activities, project facilities were grouped to reflect activities, personnel, and equipment that might be shared to optimize efficiency. Emissions have been estimated for operations and maintenance of the following project facilities:

- Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants
- Reservoirs, Recreation Facilities, Dams, Roads, Bridges
- Electrical Substations and Transmission Lines
- Tunnels, Pipelines, and Canals

Estimates of the numbers and types of equipment, vehicles, and personnel needed for operations and maintenance of the facilities were provided by DWR (DWR, 2011). Equipment and personnel requirements for operations and maintenance of facilities were assumed to be the same for Alternatives A, B, and C. Electricity generation and use rates varied for each of the alternatives, and emissions associated with electricity were estimated separately (see below).

#### **24A.2.1 Estimation of Exhaust and Fugitive Dust Emissions**

Exhaust emissions from equipment and vehicles were estimated using the same methodology described above for construction.

Fugitive dust emissions for operations and maintenance were estimated for vehicle travel on paved and unpaved roads using the methodology described above for construction.

#### **24A.2.2 Estimation of NO<sub>x</sub> Emissions from Electricity Generation**

Emissions from electricity generation were estimated using predicted system-wide net generation and consumption of electricity for each alternative, in units of GigaWatt-hours (GWh) per year, and an emission factor in units of pounds per MegaWatt-hour (MWh). The predicted system-wide net generation and consumption of electricity for each alternative was obtained from the Power and Pumping Cost Reporting Metrics - Summary, NODOS ADEIRS and FS Alternatives, dated February 8, 2011 (CH2M HILL, 2011). The emission factor for NO<sub>x</sub> was obtained from eGRID2012 for the CAMX - WECC California subregion (EPA eGRID2012 Version 1.0, Year 2009 Summary Tables, <http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html>) (EPA, 2012b).

### **24A.3 Spreadsheets and Tables**

The following spreadsheets and tables provide the information used to estimate emissions (e.g., emission factors, numbers and types of equipment and vehicles, and assumptions) and present the results of the calculations. Tables include the following:

#### **Emissions from Construction of Alternative A:**

- **Table 24A:A-1:** Construction Emissions for Alternative A – Emission Summaries by Construction Year for Criteria Pollutants
- **Table 24A:A-2:** Construction NO<sub>x</sub> Emissions for Alternative A by Project Feature

- **Table 24A.A-3:** Construction PM10 Emissions for Alternative A by Project Feature
- **Table 24A.A-4:** Construction PM2.5 Emissions for Alternative A by Project Feature
- **Table 24A.A-5:** Construction CO<sub>2</sub> Emissions for Alternative A by Project Feature
- **Table 24A.A-6:** Construction ROG Emissions for Alternative A by Project Feature
- **Table 24A.A-7:** Construction SO<sub>x</sub> Emissions for Alternative A by Project Feature
- **Table 24A.A-8:** Construction CO Emissions for Alternative A by Project Feature
- **Table 24A.A-9:** Construction Equipment Emission Factors
- **Table 24A.A-10:** Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)
- **Table 24A.A-11:** Concrete Batch Plant PM10 Emissions
- **Table 24A.A-12:** Construction Areas of Disturbance for Fugitive Dust Emissions Calculations
- **Table 24A.A-13:** Construction Emissions for Funks Reservoir Sediment Removal
- **Table 24A.A-14:** Comparison of Concrete for Alternatives (2 pages)
- **Table 24A.A-15:** Total GHG Emissions from Construction for Alternative A

#### **Emissions from Construction of Alternatives B and C:**

- **Table 24A.B-1:** Construction Emissions for Alternatives B and C – Emission Summaries by Construction Year for Criteria Pollutants
- **Table 24A.B-2:** Construction NO<sub>x</sub> Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-3:** Construction PM10 Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-4:** Construction PM2.5 Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-5:** Construction CO<sub>2</sub> Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-6:** Construction ROG Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-7:** Construction SO<sub>x</sub> Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-8:** Construction CO Emissions for Alternatives B and C by Project Feature
- **Table 24A.B-9:** Construction Equipment Emission Factors
- **Table 24A.B-10:** Equipment and Workforce for Construction of Project Features for Alternatives B and C (2 pages)
- **Table 24A.B-11:** Concrete Batch Plant PM10 Emissions
- **Table 24A.B-12:** Construction Areas of Disturbance for Fugitive Dust Emissions Calculations
- **Table 24A.B-13:** Total GHG Emissions from Construction for Alternatives B and C



### **Emissions from Project Electricity Generation and Use for All Alternatives:**

- **Table 24A.C-1:** Indirect NO<sub>x</sub> Emissions from Project Electricity Generation and Use – Emission Calculations
- **Table 24A.C-2:** Indirect NO<sub>x</sub> Emissions from Project Electricity Use for All Alternatives – Summary and Comparison

### **Emissions from Operations and Maintenance of All Alternatives:**

- **Table 24A.D-1:** Summary of Criteria Pollutant Emissions for Operations and Maintenance of Alternatives
- **Table 24A.D-2:** Operations and Maintenance NO<sub>x</sub> Emissions
- **Table 24A.D-3:** Operations and Maintenance PM<sub>10</sub> Emissions
- **Table 24A.D-4:** Operations and Maintenance PM<sub>2.5</sub> Emissions
- **Table 24A.D-5:** Operations and Maintenance ROG Emissions
- **Table 24A.D-6:** Operations and Maintenance CO Emissions
- **Table 24A.D-7:** Operations and Maintenance SO<sub>x</sub> Emissions
- **Table 24A.D-8:** Operations and Maintenance CO<sub>2</sub> Emissions
- **Table 24A.D-9:** Operations and Maintenance Equipment and Workforce Assumptions
- **Table 24A.D-10:** Operations and Maintenance Equipment Emission Factors

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California Air Resources Board (ARB), 2007. OFFROAD Model, Version 2.0.1.2. Mobile Source Emissions Inventory Program. Users Guide for OFFROAD2007. November.

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URS 2012. Joseph H. Barnes, P.E. URS Corporation. 20112. Personal Communication (e-mail) to Sean Sou on May 8, 2012, at 3:51 p.m. Sean Sou, California Department of Water Resources.

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## **Emissions from Construction of Alternative A**

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Table 24A.A-1  
Construction Emissions for Alternative A - Emission Summaries by Construction Year for Criteria Pollutants

**NODOS Construction Emissions for Alternative A**

**Average Daily Emission Rates for Criteria Pollutants by Year for Construction of Alternative A**

Construction Year	Emissions (pounds per day)					
	NOx	PM10	PM2.5	ROG	CO	SOx
2013	<b>2,171</b>	<b>344</b>	124	<b>247</b>	833	3
2014	<b>4,114</b>	<b>750</b>	247	<b>467</b>	1,604	5
2015	<b>3,639</b>	<b>655</b>	219	<b>414</b>	1,420	4
2016	<b>3,688</b>	<b>661</b>	222	<b>420</b>	1,448	4
2017	<b>1,913</b>	<b>419</b>	125	<b>216</b>	775	2
2018	<b>617</b>	<b>209</b>	55	68	267	1
2019	<b>617</b>	<b>209</b>	55	68	267	1
2020	<b>519</b>	<b>188</b>	48	57	215	1
2021	98	21	8	11	52	0
Significance Threshold (lb/day)	137	137	n/a	137	n/a	n/a

Notes:

1. The average daily construction emission rates in lb/day for each construction year are the sum of the average daily emission rates estimated for each of the project features that would be constructed in the indicated construction year.
2. Bolded values indicate an exceedance of the significance threshold.
3. Significance Threshold is from TCAPCD Level C: Greater than 137 pounds per day of emissions. If emissions from a project would exceed the Level C thresholds, mitigation measures (BAMMs and SMMs), including off-site mitigation measures following the guidelines, may be required to reduce the overall air quality impacts of the project to a level of insignificance (TCAPCD 2009).

Bolded values indicate an exceedance of the significance threshold.

Table 24A.A-2  
Construction NO<sub>x</sub> Emissions for Alternative A by Project Feature

NODOS  
Construction  
NO<sub>x</sub> Emissions  
Alternative A

Equipment	NO <sub>x</sub> Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	6,704	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	2,909
Boom Truck	0	0	0	0	0	0	0	0	0	0	439	0
Bulldozer	873	23,241	31,779	84,180	31,779	372,344	48,009	256,473	7,611	266,505	3,273	3,164
Compactor	50	21	63	293	63	250	0	2,556	49	0	0	0
Concrete Pumper	0	0	49	0	49	90	144	506	0	131	0	0
Concrete Truck	2,784	0	7,425	1,481	7,425	3,141	18,384	6,130	0	40,088	2,070	1,178
Crane	0	0	1,988	14,907	1,988	0	3,478	0	0	9,938	1,153	0
Dump Truck	13,708	0	22,311	154,747	22,311	143	10,709	7,852	2,195	120,924	4,212	8,460
Excavator	0	0	0	3,569	0	0	0	0	0	232	518	0
Fuel Truck	5,979	3,302	5,944	17,260	5,944	10,174	9,852	33,563	1,660	20,097	3,623	5,569
Forklift	0	591	1,689	6,335	1,689	249	2,154	199	0	0	490	511
Generator	1,171	0	781	4,377	781	165	1,501	322	0	3,753	218	248
Grader	0	369	2,237	5,222	2,237	4,451	6,396	45,488	1,163	23,528	0	313
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	1,154	914	751	8,018	751	920	2,404	11,350	246	7,423	349	950
Off-road Truck	0	27,130	0	0	0	26,594	0	263,359	0	81,389	0	0
Paver	276	167	0	0	0	0	0	0	42	668	0	184
Pile Driver	0	0	0	0	0	427	0	5,194	0	0	0	0
Roller	412	0	0	0	0	0	0	62	5,779	0	0	312
Scissor Lift	0	0	0	0	0	0	183	0	0	0	0	0
Scraper	3,900	18,425	32,922	388,118	32,922	323,855	87,322	101,848	4,154	246,876	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	1,543	1,619	3,508	7,280	3,508	17,164	2,650	28,312	1,438	16,953	437	1,084
Welding Truck	0	0	0	2,522	0	0	741	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	4,269	4,395	11,050	40,898	11,050	28,304	24,537	156,558	0	31,462	4,159	2,876
Personnel Vehicles	308	397	1,841	478	1,841	2,124	409	3,688	501	1,623	100	251
Unpaved roads	560	685	1,104	4,495	1,104	2,360	1,683	12,051	106	5,741	540	380
<b>Total Emissions (lbs)</b>	<b>36,988</b>	<b>81,254</b>	<b>125,441</b>	<b>744,180</b>	<b>125,441</b>	<b>792,755</b>	<b>220,558</b>	<b>935,448</b>	<b>19,228</b>	<b>889,816</b>	<b>21,580</b>	<b>28,388</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	49.8	166.8	98.3	1355.5	98.3	959.8	454.8	420.6	13.7	634.2	58.8	38.8

Daily Emissions  
(lb/day) in Year

2013	49.8					959.8	454.8		13.7	634.2	58.8	
2014	49.8	166.8		1355.5		959.8	454.8	420.6	13.7	634.2	58.8	
2015	49.8	166.8		1355.5		959.8		420.6	13.7	634.2		38.8
2016		166.8		1355.5	98.3	959.8		420.6	13.7	634.2		38.8
2017				1355.5	98.3			420.6				38.8
2018			98.3		98.3			420.6				
2019			98.3		98.3			420.6				
2020			98.3					420.6				
2021			98.3									
2022												

Total lb/day NO <sub>x</sub> for Features Constructed In the Indicated Year		Year
		2,171.02
		4,114.00
		3,639.28
		3,687.80
		1,913.28
		617.23
		617.23
		518.92
		98.31
		-

Table 24A.A-3  
Construction PM10 Emissions for Alternative A by Project Feature

NODOS  
Construction  
PM10 Emissions  
Alternative A

Equipment	PM10 Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations, Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	561	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	171
Boom Truck	0	0	0	0	0	0	0	0	0	0	37	0
Bulldozer	36	964	1,318	3,492	1,318	15,445	1,992	10,639	316	11,055	136	131
Compactor	2	1	2	11	2	10	0	99	2	0	0	0
Concrete Pumper	0	0	2	0	2	4	6	23	0	6	0	0
Concrete Truck	99	0	263	52	263	111	651	217	0	1,419	73	42
Crane	0	0	70	524	70	0	122	0	0	349	40	0
Dump Truck	485	0	790	5,479	790	5	379	278	78	4,282	149	300
Excavator	0	0	0	204	0	0	0	0	0	13	30	0
Fuel Truck	212	117	210	611	210	360	349	1,188	59	712	128	197
Forklift	0	34	97	364	97	14	124	11	0	0	28	29
Generator	91	0	60	339	60	13	116	25	0	291	17	19
Grader	0	21	126	294	126	251	360	2,561	65	1,325	0	18
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	101	80	66	699	66	80	210	990	21	647	30	83
Off-road Truck	0	961	0	0	0	942	0	9,325	0	2,882	0	0
Paver	24	15	0	0	0	0	0	0	4	58	0	16
Pile Driver	0	0	0	0	0	28	0	338	0	0	0	0
Roller	35	0	0	0	0	0	0	0	5	493	0	27
Scissor Lift	0	0	0	0	0	0	15	0	0	0	0	0
Scraper	151	715	1,277	15,056	1,277	12,563	3,387	3,951	161	9,577	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	51	54	117	242	117	570	88	940	48	563	15	36
Welding Truck	0	0	0	236	0	0	69	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	202	208	523	1,935	523	1,339	1,161	7,406	0	1,488	197	136
Personnel Vehicles	456	587	2,726	708	2,726	3,145	605	5,460	742	2,404	147	371
Unpaved Roads	9,617	11,752	18,951	77,154	18,951	40,512	28,895	206,846	1,826	98,545	9,273	6,522
<b>Fugitive PM Sources</b>												
Concrete Batch Plant	15	0	10	10	10	10	10	6	0	15	10	5
Disturbed Areas	131	1,916	268	4,075	7	4,563	2,309	121,791	0	13,109	3,728	12,084
<b>Total Emissions (lbs)</b>	<b>11,707</b>	<b>17,423</b>	<b>26,876</b>	<b>111,485</b>	<b>26,615</b>	<b>79,965</b>	<b>40,849</b>	<b>372,096</b>	<b>3,326</b>	<b>149,793</b>	<b>14,039</b>	<b>20,187</b>

Highway truck and personnel vehicle emissions include paved road dust emissions.

The unpaved road emissions include fugitive dust from travel over unpaved roads.

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0

Construction												
Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	15.8	35.8	21.1	203.1	20.9	96.8	84.2	167.3	2.4	106.8	38.3	27.6

Daily Emissions  
(lb/day) in Year

2013	15.8					96.8	84.2		2.4	106.8	38.3	
2014	15.8	35.8		203.1		96.8	84.2	167.3	2.4	106.8	38.3	
2015	15.8	35.8		203.1		96.8		167.3	2.4	106.8		27.6
2016		35.8		203.1	20.9	96.8		167.3	2.4	106.8		27.6
2017				203.1	20.9			167.3				27.6
2018			21.1		20.9			167.3				
2019			21.1		20.9			167.3				
2020			21.1					167.3				
2021			21.1									
2022												

Total Today PM10 for Features Constructed in the Indicated Year		Year
344.18		2013
750.34		2014
655.47		2015
660.57		2016
418.85		2017
209.23		2018
209.23		2019
188.37		2020
21.06		2021
-		2022

Table 24A.A-4  
Construction PM2.5 Emissions for Alternative A by Project Feature

NODOS  
Construction  
PM2.5 Emissions  
Alternative A

Equipment	PM2.5 Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations, Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	561	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	171
Boom Truck	0	0	0	0	0	0	0	0	0	0	37	0
Bulldozer	36	964	1,318	3,492	1,318	15,445	1,992	10,639	316	11,055	136	131
Compactor	2	1	2	11	2	10	0	99	2	0	0	0
Concrete Pumper	0	0	2	0	2	4	6	23	0	6	0	0
Concrete Truck	99	0	263	52	263	111	651	217	0	1,419	73	42
Crane	0	0	70	524	70	0	122	0	0	349	40	0
Dump Truck	485	0	790	5,479	790	5	379	278	78	4,282	149	300
Excavator	0	0	0	204	0	0	0	0	0	13	30	0
Fuel Truck	212	117	210	611	210	360	349	1,188	59	712	128	197
Forklift	0	34	97	364	97	14	124	11	0	0	28	29
Generator	91	0	60	339	60	13	116	25	0	291	17	19
Grader	0	21	126	294	126	251	360	2,561	65	1,325	0	18
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	101	80	66	699	66	80	210	990	21	647	30	83
Off-road Truck	0	961	0	0	0	942	0	9,325	0	2,882	0	0
Paver	24	15	0	0	0	0	0	0	4	58	0	16
Pile Driver	0	0	0	0	0	28	0	338	0	0	0	0
Roller	35	0	0	0	0	0	0	0	5	493	0	27
Scissor Lift	0	0	0	0	0	0	15	0	0	0	0	0
Scraper	151	715	1,277	15,056	1,277	12,563	3,387	3,951	161	9,577	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	51	54	117	242	117	570	88	940	48	563	15	36
Welding Truck	0	0	0	236	0	0	69	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	202	208	523	1,935	523	1,339	1,161	7,406	0	1,488	197	136
Personnel Vehicles	456	587	2,726	708	2,726	3,145	605	5,460	742	2,404	147	371
Unpaved Roads	977	1,194	1,926	7,841	1,926	4,117	2,937	21,021	186	10,015	942	663
<b>Fugitive PM Sources</b>												
Concrete Batch Plant	15	0	10	10	10	10	10	6	0	15	10	5
Disturbed Areas	27	399	56	847	1	949	480	25,333	0	2,727	775	2,514
<b>Total Emissions (lbs)</b>	<b>2,964</b>	<b>5,348</b>	<b>9,639</b>	<b>38,945</b>	<b>9,585</b>	<b>39,956</b>	<b>13,062</b>	<b>89,812</b>	<b>1,686</b>	<b>50,881</b>	<b>2,755</b>	<b>4,757</b>

Highway truck and personnel vehicle emissions include paved road dust emissions.

The unpaved road emissions include fugitive dust from travel over unpaved roads.

PM<sub>2.5</sub> fugitive dust emissions were calculated following the SCAQMD Particulate Matter (PM) 2.5 Significance

Thresholds and Calculation Methodology, October 2006. For construction fugitive dust sources, it is

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	4.0	11.0	7.6	70.9	7.5	48.4	26.9	40.4	1.2	36.3	7.5	6.5

Daily Emissions  
(lb/day) in Year

2013	4.0					48.4	26.9		1.2	36.3	7.5	
2014	4.0	11.0		70.9		48.4	26.9	40.4	1.2	36.3	7.5	
2015	4.0	11.0		70.9		48.4		40.4	1.2	36.3		6.5
2016		11.0		70.9	7.5	48.4		40.4	1.2	36.3		6.5
2017				70.9	7.5			40.4				6.5
2018			7.6		7.5			40.4				
2019			7.6		7.5			40.4				
2020			7.6					40.4				
2021			7.6									
2022												

Total lb/day PM2.5 for Features Constructed in the Indicated Year		Year
124.27		2013
246.57		2014
218.64		2015
222.16		2016
125.34		2017
55.45		2018
55.45		2019
47.94		2020
7.55		2021
-		2022

Table 24A.A-5  
Construction CO<sub>2</sub> Emissions for Alternative A by Project Feature

NODOS  
Construction CO<sub>2</sub>  
Emissions  
Alternative A

Equipment	CO <sub>2</sub> Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	418,214	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	154,601
Bloom Truck	0	0	0	0	0	0	0	0	0	0	21,652	0
Bulldozer	50,007	1,331,438	1,820,570	4,822,556	1,820,570	21,331,137	2,750,388	14,693,012	435,999	15,267,781	187,526	181,276
Compactor	2,949	1,224	3,710	17,325	3,710	14,765	0	150,806	2,894	0	0	0
Concrete Pumper	0	0	3,681	0	3,681	6,795	10,830	38,135	0	9,910	0	0
Concrete Truck	242,155	0	645,747	128,839	645,747	273,201	1,598,845	533,114	0	3,486,414	180,064	102,450
Crane	0	0	96,455	723,414	96,455	0	168,797	0	0	482,276	55,944	0
Dump Truck	1,192,149	0	1,940,346	13,458,243	1,940,346	12,418	931,366	682,847	190,930	10,516,678	366,337	735,779
Excavator	0	0	0	255,861	0	0	0	0	0	16,631	37,100	0
Fuel Truck	520,013	287,171	516,908	1,501,052	516,908	884,798	856,857	2,918,964	144,362	1,747,864	315,112	484,310
Forklift	0	23,542	67,264	252,240	67,264	9,921	85,762	7,932	0	0	19,507	20,347
Generator	89,983	0	59,989	336,284	59,989	12,690	115,363	24,763	0	288,408	16,728	19,035
Grader	0	24,945	151,182	353,009	151,182	300,851	432,379	3,074,843	78,614	1,590,430	0	21,165
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	61,081	48,355	39,766	424,383	39,766	48,674	127,251	600,750	13,043	392,888	18,451	50,264
Off-road Truck	0	2,359,461	0	0	0	2,312,893	0	22,904,160	0	7,078,384	0	0
Paver	14,157	8,580	0	0	0	0	0	0	2,145	34,321	0	9,438
Pile Driver	0	0	0	0	0	49,164	0	598,393	0	0	0	0
Roller	21,802	0	0	0	0	0	0	0	3,303	305,557	0	16,517
Scissor Lift	0	0	0	0	0	0	9,022	0	0	0	0	0
Scraper	319,366	1,508,890	2,696,100	31,783,891	2,696,100	26,521,289	7,151,028	8,340,552	340,195	20,217,276	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	207,705	217,837	472,148	979,758	472,148	2,310,082	356,644	3,810,500	193,520	2,281,712	58,765	145,900
Welding Truck	0	0	0	116,809	0	0	34,342	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	959,035	987,242	2,482,208	9,186,992	2,482,208	6,357,838	5,511,631	35,167,590	0	7,067,242	934,213	645,938
Personnel Vehicles	1,157,796	1,491,588	6,924,960	1,799,482	6,924,960	7,989,098	1,537,584	13,870,751	1,884,703	6,106,437	374,684	942,701
Unpaved roads	122,701	149,943	241,797	984,415	241,797	516,902	368,676	2,639,184	23,293	1,257,346	118,318	83,213
<b>Total Emissions (lbs)</b>	<b>4,960,900</b>	<b>8,440,218</b>	<b>18,162,831</b>	<b>67,124,552</b>	<b>18,162,831</b>	<b>68,952,518</b>	<b>22,046,767</b>	<b>110,056,396</b>	<b>3,313,001</b>	<b>78,565,769</b>	<b>2,704,401</b>	<b>3,612,935</b>
<b>Total Emissions (metric tons)</b>	<b>2,250</b>	<b>3,828</b>	<b>8,239</b>	<b>30,447</b>	<b>8,239</b>	<b>31,276</b>	<b>10,000</b>	<b>49,921</b>	<b>1,503</b>	<b>35,637</b>	<b>1,227</b>	<b>1,639</b>
<b>CONSTRUCTION TOTAL (metric tons)</b>	<b>184,205</b>											
<b>Construction Duration</b>												
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	6676.9	17331.0	14234.2	122266.9	14234.2	83477.6	45457.3	49485.8	2361.4	55998.4	7368.9	4942.5

Ave. Annual  
Emissions (mt/yr) in  
Year

2013	750.1					7819.1	5000.1		375.7	8909.2	613.3	
2014	750.1	1276.1		7611.8		7819.1	5000.1	7131.5	375.7	8909.2	613.3	
2015	750.1	1276.1		7611.8		7819.1		7131.5	375.7	8909.2		546.3
2016		1276.1		7611.8	2059.6	7819.1		7131.5	375.7	8909.2		546.3
2017				7611.8	2059.6			7131.5				546.3
2018			2059.6		2059.6			7131.5				
2019			2059.6		2059.6			7131.5				
2020			2059.6					7131.5				
2021			2059.6									
2022												

Total mt/yr CO <sub>2</sub> for Features Constructed In the Indicated Year		Year
23,467.55		2013
39,487.04		2014
34,419.83		2015
35,729.39		2016
17,349.25		2017
11,250.81		2018
11,250.81		2019
9,191.18		2020
2,059.63		2021
-		2022

184,205.50	CONSTRUCTION TOTAL (metric tons)
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Table 24A.A-6  
Construction ROG Emissions for Alternative A by Project Feature

NODUS  
Construction ROG  
Emissions  
Alternative A

Equipment	ROG Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	1,019	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	392
Boom Truck	0	0	0	0	0	0	0	0	0	0	139	0
Bulldozer	103	2,730	3,732	9,887	3,732	43,730	5,638	30,122	894	31,300	384	372
Compactor	8	3	10	47	10	40	0	408	8	0	0	0
Concrete Pumper	0	0	8	0	8	14	23	80	0	21	0	0
Concrete Truck	338	0	900	180	900	381	2,229	743	0	4,860	251	143
Crane	0	0	208	1,559	208	0	364	0	0	1,039	121	0
Dump Truck	1,662	0	2,705	18,762	2,705	17	1,298	952	266	14,661	511	1,026
Excavator	0	0	0	482	0	0	0	0	0	31	70	0
Fuel Truck	725	400	721	2,093	721	1,234	1,195	4,069	201	2,437	439	675
Forklift	0	79	226	848	226	33	288	27	0	0	66	68
Generator	169	0	113	633	113	24	217	47	0	543	31	36
Grader	0	48	293	684	293	583	837	5,955	152	3,080	0	41
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	186	147	121	1,293	121	148	388	1,831	40	1,197	56	153
Off-road Truck	0	3,289	0	0	0	3,224	0	31,931	0	9,868	0	0
Paver	46	28	0	0	0	0	0	0	7	111	0	30
Pile Driver	0	0	0	0	0	38	0	461	0	0	0	0
Roller	65	0	0	0	0	0	0	0	10	911	0	49
Scissor Lift	0	0	0	0	0	0	58	0	0	0	0	0
Scraper	439	2,074	3,706	43,693	3,706	36,459	9,831	11,466	468	27,793	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	174	183	396	822	396	1,938	299	3,197	162	1,914	49	122
Welding Truck	0	0	0	959	0	0	282	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	242	249	626	2,317	626	1,604	1,390	8,870	0	1,782	236	163
Personnel Vehicles	42	54	250	65	250	288	56	501	68	220	14	34
Unpaved roads	67	81	131	535	131	281	200	1,433	13	683	64	45
<b>Total Emissions (lbs)</b>	<b>4,265</b>	<b>9,366</b>	<b>14,147</b>	<b>84,858</b>	<b>14,147</b>	<b>90,036</b>	<b>24,593</b>	<b>102,092</b>	<b>2,289</b>	<b>103,472</b>	<b>2,431</b>	<b>3,350</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	5.7	19.2	11.1	154.6	11.1	109.0	50.7	45.9	1.6	73.8	6.6	4.6

Daily Emissions  
(lb/day) in Year

2013	5.7					109.0	50.7		1.6	73.8	6.6	
2014	5.7	19.2		154.6		109.0	50.7	45.9	1.6	73.8	6.6	
2015	5.7	19.2		154.6		109.0		45.9	1.6	73.8		4.6
2016		19.2		154.6	11.1	109.0		45.9	1.6	73.8		4.6
2017				154.6	11.1			45.9				4.6
2018			11.1		11.1			45.9				
2019			11.1		11.1			45.9				
2020			11.1					45.9				
2021			11.1									
2022												

Total lb/day ROG for Features Constructed In the Indicated Year	Year
247.45	2013
467.16	2014
414.41	2015
419.76	2016
216.14	2017
68.08	2018
68.08	2019
56.99	2020
11.09	2021
-	2022

Table 24A.A-7  
Construction SOx Emissions for Alternative A by Project Feature

NODOS  
Construction SOx  
Emissions  
Alternative A

Equipment	SOx Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	8	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	3
Boom Truck	0	0	0	0	0	0	0	0	0	0	1	0
Bulldozer	1	20	27	72	27	318	41	219	6	227	3	3
Compactor	0	0	0	1	0	0	0	5	0	0	0	0
Concrete Pumper	0	0	0	0	0	0	0	1	0	0	0	0
Concrete Truck	4	0	10	2	10	4	25	8	0	54	3	2
Crane	0	0	2	18	2	0	4	0	0	12	1	0
Dump Truck	18	0	30	208	30	0	14	11	3	162	6	11
Excavator	0	0	0	5	0	0	0	0	0	0	1	0
Fuel Truck	8	4	8	23	8	14	13	45	2	27	5	7
Forklift	0	1	2	9	2	0	3	0	0	0	1	1
Generator	1	0	1	5	1	0	2	0	0	4	0	0
Grader	0	0	3	6	3	5	7	53	1	28	0	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	1	1	1	8	1	1	2	12	0	8	0	1
Off-road Truck	0	36	0	0	0	36	0	353	0	109	0	0
Paver	0	0	0	0	0	0	0	0	0	1	0	0
Pile Driver	0	0	0	0	0	1	0	8	0	0	0	0
Roller	0	0	0	0	0	0	0	0	0	6	0	0
Scissor Lift	0	0	0	0	0	0	0	0	0	0	0	0
Scraper	4	18	33	388	33	324	87	102	4	247	0	0
Tunnel Boring	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	3	3	6	12	6	29	4	47	2	28	1	2
Welding Truck	0	0	0	3	0	0	1	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	9	9	23	85	23	59	51	327	0	66	9	6
Personnel Vehicles	11	15	68	18	68	79	15	137	19	60	4	9
Unpaved roads	1	1	2	9	2	5	4	25	0	12	1	1
<b>Total Emissions (lbs)</b>	<b>62</b>	<b>109</b>	<b>217</b>	<b>872</b>	<b>217</b>	<b>875</b>	<b>275</b>	<b>1,354</b>	<b>39</b>	<b>1,059</b>	<b>34</b>	<b>47</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	0.1	0.2	0.2	1.6	0.2	1.1	0.6	0.6	0.0	0.8	0.1	0.1

Daily Emissions  
(lb/day) in Year

2013	0.1					1.1	0.6		0.0	0.8	0.1	
2014	0.1	0.2		1.6		1.1	0.6	0.6	0.0	0.8	0.1	
2015	0.1	0.2		1.6		1.1		0.6	0.0	0.8		0.1
2016		0.2		1.6	0.2	1.1		0.6	0.0	0.8		0.1
2017				1.6	0.2			0.6				0.1
2018			0.2		0.2			0.6				
2019			0.2		0.2			0.6				
2020			0.2					0.6				
2021			0.2									
2022												

Total lb/day SOx for Features Constructed In the Indicated Year		Year
2.59		2013
5.01		2014
4.41		2015
4.50		2016
2.43		2017
0.95		2018
0.95		2019
0.78		2020
0.17		2021
-		2022

Table 24A.A-8  
Construction CO Emissions for Alternative A by Project Feature

NODOS  
Construction CO  
Emissions  
Alternative A

Equipment	CO Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites P/G Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	5,181	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	1,805
Boom Truck	0	0	0	0	0	0	0	0	0	0	417	0
Bulldozer	228	6,082	8,316	22,029	8,316	97,440	12,564	67,117	1,992	69,743	857	828
Compactor	42	17	53	246	53	209	0	2,140	41	0	0	0
Concrete Pumper	0	0	40	0	40	74	118	415	0	108	0	0
Concrete Truck	991	0	2,643	527	2,643	1,118	6,544	2,182	0	14,269	737	419
Crane	0	0	589	4,416	589	0	1,030	0	0	2,944	341	0
Dump Truck	4,879	0	7,942	55,083	7,942	51	3,812	2,795	781	43,043	1,499	3,011
Excavator	0	0	0	2,664	0	0	0	0	0	173	386	0
Fuel Truck	2,128	1,175	2,116	6,144	2,116	3,621	3,507	11,947	591	7,154	1,290	1,982
Forklift	0	462	1,320	4,950	1,320	195	1,683	156	0	0	383	399
Generator	763	0	508	2,850	508	108	978	210	0	2,444	142	161
Grader	0	242	1,467	3,427	1,467	2,920	4,197	29,847	763	15,438	0	205
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	796	631	519	5,533	519	635	1,659	7,833	170	5,123	241	655
Off-road Truck	0	9,657	0	0	0	9,466	0	93,744	0	28,971	0	0
Paver	167	101	0	0	0	0	0	0	25	404	0	111
Pile Driver	0	0	0	0	0	399	0	4,855	0	0	0	0
Roller	268	0	0	0	0	0	0	0	41	3,755	0	203
Scissor Lift	0	0	0	0	0	0	174	0	0	0	0	0
Scraper	1,670	7,888	14,095	166,159	14,095	138,647	37,384	43,602	1,778	105,691	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	479	502	1,088	2,257	1,088	5,322	822	8,779	446	5,257	135	336
Welding Truck	0	0	0	2,723	0	0	801	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	1,091	1,123	2,825	10,455	2,825	7,235	6,272	40,020	0	8,042	1,063	735
Personnel Vehicles	3,675	4,734	21,979	5,711	21,979	25,357	4,880	44,025	5,982	19,381	1,189	2,992
Unpaved roads	188	230	371	1,511	371	793	566	4,051	36	1,930	182	128
<b>Total Emissions (lbs)</b>	<b>17,365</b>	<b>32,845</b>	<b>65,870</b>	<b>296,685</b>	<b>65,870</b>	<b>293,591</b>	<b>86,990</b>	<b>363,718</b>	<b>12,646</b>	<b>339,052</b>	<b>8,862</b>	<b>13,972</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
Emissions (lb/day)	23.4	67.4	51.6	540.4	51.6	355.4	179.4	163.5	9.0	241.7	24.1	19.1

Daily Emissions  
(lb/day) in Year

2013	23.4					355.4	179.4		9.0	241.7	24.1	
2014	23.4	67.4		540.4		355.4	179.4	163.5	9.0	241.7	24.1	
2015	23.4	67.4		540.4		355.4		163.5	9.0	241.7		19.1
2016		67.4		540.4	51.6	355.4		163.5	9.0	241.7		19.1
2017				540.4	51.6			163.5				19.1
2018			51.6		51.6			163.5				
2019			51.6		51.6			163.5				
2020			51.6					163.5				
2021			51.6									
2022												

Total lb/day CO for Features Constructed In the Indicated Year		Year
832.99		2013
1,604.39		2014
1,420.00		2015
1,448.25		2016
774.69		2017
266.79		2018
266.79		2019
215.16		2020
51.62		2021
-		2022

Table 24A.A9  
Construction Equipment Emission Factors

**NODOS Construction - Emission Factors**

**Construction Equipment Emission Factors**

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.55	75	5.015	0.42	312.846	0.762	0.006	3.876	0.42
Bobcat	Other General Industrial	0.51	150	5.458	0.32	290.093	0.735	0.006	3.386	0.32
Boom Truck	Aerial Lift	0.46	34	5.307	0.443	261.653	1.676	0.007	5.042	0.443
Bulldozer	Rubber Tired Dozer	0.59	358	5.858	0.243	335.598	0.688	0.005	1.533	0.243
Compactor	Plate Compactor	0.43	8	4.142	0.161	244.589	0.661	0.008	3.469	0.161
Concrete Pumper	Cement and Mortar Mixer	0.56	9	4.223	0.191	318.534	0.669	0.008	3.469	0.191
Concrete Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Crane	Crane	0.43	208	5.04	0.177	244.589	0.527	0.006	1.493	0.177
Dump Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Excavator	Excavator	0.57	157	4.523	0.259	324.222	0.611	0.006	3.376	0.259
Fuel Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Forklift	Forklift	0.30	149	4.286	0.246	170.643	0.574	0.006	3.349	0.246
Generator	Generator set	0.74	84	5.478	0.424	420.920	0.792	0.006	3.567	0.424
Grader	Grader	0.61	162	5.133	0.289	346.974	0.672	0.006	3.368	0.289
Highway Truck	Estimated with EMFAC2007 emission factors and by assuming 10 one-way trips per equipment day (5 round trips)									
Loader	Rubber Tired Loader	0.54	87	5.803	0.506	307.158	0.936	0.006	4.005	0.506
Off-road Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Paver	Paver	0.62	89	6.863	0.598	352.663	1.139	0.006	4.153	0.598
Pile Driver	Bore/Drill Rig	0.75	82	3.703	0.241	426.608	0.329	0.006	3.461	0.241
Roller	Roller	0.56	84	6.024	0.514	318.534	0.95	0.006	3.914	0.514
Scissor Lift	Aerial Lift	0.46	34	5.307	0.443	261.653	1.676	0.007	5.042	0.443
Scraper	Scraper	0.72	356	5.001	0.194	409.544	0.563	0.005	2.141	0.194
Tunnel Boring Machine	ASSUME ELECTRIC									
Water Trucks	Water Truck	0.75	189	2.409	0.08	324.222	0.272	0.004	0.747	0.08
Welding Truck	Welder	0.45	46	5.526	0.517	255.965	2.101	0.007	5.967	0.517

1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (Environ, 2011). The CO2 emission factors are from Appendix I of the URBEMIS2007 for Windows Users Guide (2007).
2. The emission factors are for the year 2013.
3. It was assumed emissions from concrete trucks, fuel trucks, and dump trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the construction area, for example, concrete trucks making trips from an onsite concrete batch plant to the pour location.

**Vehicle Emission Factors**

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	1.2237	0.0001	0.0000	0.0030	0.0001
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.6717	0.0000	0.0000	0.0021	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0261	0.0010	5.7230	0.0031	0.0001	0.0088	0.0008
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0179	0.0006	4.0296	0.0010	0.0000	0.0046	0.0005
Vehicle	Vehicle Type in EMFAC2007	Emission Factors (g/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.111	0.04	555.078	0.03	0.005	1.346	0.025
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.081	0.028	304.669	0.011	0.003	0.967	0.014
Truck at 15 mph	Heavy-Heavy Duty Diesel	11.854	0.45	2595.958	1.41	0.025	3.985	0.376
Truck at 35 mph	Heavy-Heavy Duty Diesel	8.137	0.293	1827.808	0.461	0.017	2.08	0.232

1. It was assumed that 'non-personnel' trips are diesel truck trips.
2. Emission factors from the California Air Resources Board's EMFAC 2007 model for the Colusa County portion of the Sacramento Valley Air Basin. It was assumed that diesel trucks would be ten years old or newer so the model year in EMFAC was changed to 2000 through 2013, rather than the default of 1969- 2013.
3. Truck age assumption based on the ARB Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014, December 2009.
4. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.
5. The PM10 and PM2.5 emission factors include tire and brake wear.

**Calculation of Paved Road Emission Factor**

Paved Roads emission factor from AP-42, Section 13.2.1: Paved Roads (1/11)

$$E = [k(sL)^{0.91} \cdot (W)^{1.02}]$$

where:

k =	1.0	particle size multiplier, g/VTM [Table 13.2.1-1]
sL =	0.03	road surface silt loading (g/m <sup>2</sup> ) [Table 13.2.1-2]
W =	2.2	vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (Environ, 2011)]
E (PM10) =	0.092	g/VTM

**Calculation of Unpaved Road Emission Factor**

**PM10**

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)<sup>0.9</sup> x (average vehicle weight [tons] / 3)<sup>0.45</sup> x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	50
Emission Factor (lb/mile)	0.45

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road  
Reference for Precipitation: WRCC, Hollister CA, <http://www.wrcc.dri.edu/cgi-bin/cliGCSIP.pl?ca4025>  
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

**PM2.5**

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)<sup>0.9</sup> x (average vehicle weight [tons] / 3)<sup>0.45</sup> x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	PM <sub>2.5</sub>
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	50
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road  
Reference for Precipitation: WRCC, Hollister CA, <http://www.wrcc.dri.edu/cgi-bin/cliGCSIP.pl?ca4025>  
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

**Disturbed Land Fugitive Dust Emission Factor**

Emission Factor (lb/acre/day) 10  
From URBEMIS2007 construction phase mass site grading.  
Per URBEMIS2007 Appendix A, page A-6, the value assumes watering.

NODOS Construction

Table 24A.A-10  
Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)

Project Features: Constr. Schedule (7/12/11 Update)	GCID Canal & Headworks			TRR			Delevan Intake & P/G Plant			TRR & Delevan Pipelines			TRR Pumping Plant			New Holthouse Reservoir		
	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
	743	7/3/2013	7/15/2015	487	7/2/2014	10/30/2016	1276	5/15/2018	11/8/2021	Delevan: 459 TRR: 549	4/1/2015	7/2/2017	1276	12/18/2015	6/19/2019	826	4/1/2013	7/9/2016
Equipment	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day
Backhoe																		
Bobcat																		
Boom Truck																		
Bulldozer	1	32	10	1	852	10	1	1165	10	1	3086	10	1	1165	10	1	13650	10
Compactor	1	159	10	1	66	10	1	200	10	1	934	10	1	200	10	1	796	10
Concrete Pumper							1	104	10				1	104	10	1	192	10
Concrete Truck	1	156	10				1	416	10	1	83	10	1	416	10	1	176	10
Crane							1	200	10	1	1500	10	1	200	10			
Dump Truck	1	768	10				1	1250	10	1	8670	10	1	1250	10	1	8	10
Excavator										1	400	10						
Fuel Truck	1	335	10	1	185	10	1	333	10	1	967	10	1	333	10	1	570	10
Forklift				1	140	10	1	400	10	1	1500	10	1	400	10	1	59	10
Generator	1	156	10				1	104	10	1	583	10	1	104	10	1	22	10
Grader				1	33	10	1	200	10	1	467	10	1	200	10	1	398	10
Highway Truck	1	680	10	1	700	10	1	1760	10	1	6514	10	1	1760	10	1	4508	10
Loader	1	192	10	1	152	10	1	125	10	1	1334	10	1	125	10	1	153	10
Off-road Truck				1	1520	10										1	1490	10
Paver	1	33	10	1	20	10												
Pile Driver/Drill Rig																1	85	10
Roller	1	66	10															
Scissor Lift																		
Scraper	1	138	10	1	652	10	1	1165	10	1	13734	10	1	1165	10	1	11460	10
Tunnel Boring Machine																		
Water Trucks	1	205	10	1	215	10	1	466	10	1	967	10	1	466	10	1	2280	10
Welding Truck										1	1000	10						
Trips/Workforce	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.
Highway Trucks	3400	70	29	3500	70	57	8800	70	101	32570	70	61	8800	70	101	22540	70	180
Personnel	21547	80		27759	80		128876	80		33489	80		128876	80		148680	80	
Onsite Unpaved roads	10720	2		13100	2		21125	2		86005	2		21125	2		45160	2	

Source: URS 2011.

NODOS Construction

Table 24A.A-10  
Equipment and Workforce for Construction of Project Features for Alternative A (2 pages)

Inlet/Outlet Structure and Tunnel and Sites Pumping Plant			Dams and Sites Inundation (Alternative A)			Gravel Roads			Paved Roads & Bridge			Substations & Transmission Lines			Recreation Facilities		
Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
243 (WO)	1/1/2013	8/31/2013	885 (saddle)	7/2/2014	12/2/2016	1403	1/1/2013	11/3/2016	1403	1/1/2013	11/3/2016	367	6/29/2013	6/30/2014	731	1/2/2015	1/1/2017
212 (Tunnel)	10/1/2013	4/30/2014	1949 (GG)	7/2/2014	11/1/2019												
485	1/1/2013	4/30/2014	792 (Sites)	7/2/2016	8/30/2020												
			2224	7/2/2014	8/30/2020												
Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day
									1	1470	10				1	316	10
												1	240	10			
1	1760	10	1	9402	10	1	279	10	1	9770	10	1	120	10	1	116	10
			1	8136	10	1	156	10									
1	306	10	1	1077	10				1	280	10						
1	1030	10	1	343	10				1	2246	10	1	116	10	1	66	10
1	350	10							1	1000	10	1	116	10			
1	600	10	1	440	10	1	123	10	1	6775	10	1	236	10	1	474	10
									1	26	10	1	58	10			
1	552	10	1	1880	10	1	93	10	1	1126	10	1	203	10	1	312	10
1	510	10	1	47	10							1	116	10	1	121	10
1	200	10	1	43	10				1	500	10	1	29	10	1	33	10
1	572	10	1	4068	10	1	104	10	1	2104	10				1	28	10
1	3908	10	1	24935	10				1	5011	10	1	552	10	1	458	10
1	400	10	1	1888	10	1	41	10	1	1235	10	1	58	10	1	158	10
			1	14755	10				1	4560	10						
						1	5	10	1	80	10				1	22	10
			1	1035	10					105							
						1	10	10	1	925	10				1	50	10
1	100	10															
1	3090	10	1	3604	10	1	147	10	1	8736	10						
1	200	24															
1	352	10	1	3761	10	1	191	10	1	2252	10	1	58	10	1	144	10
1	294	10															
Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.
19540	70	59	124677	70	116	0	70	25	25055	70	81	3312	70	19	2290	70	24
28615	80		258140	80		35075	80		113643	80		6973	80		17544	80	
32210	2		230577	2		2035	2		109850	2		10337	2		7270	2	

NODOS Construction Emissions

Table 24A.A-11  
Concrete Batch Plant PM10 Emissions

**Construction On-Site Concrete Batch Plant Emissions**

Project Feature	Total Concrete Mass (tons)	Number of Days	Daily Rate (tons/day)	PM <sub>10</sub> Emissions (lb/day)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	194	400	10.14
Pipelines - Delevans and TRR	11,100	28	396	10.07
Dams & Sites Inundation	49,852	215	232	6.24
TRR Pump Plant	55,500	139	399	10.13
Funks Reservoir Modification	23,773	59	403	10.22
Sacramento River Intake & P/G Plant	55,500	139	399	10.13
Paved Roads & Bridges	186,110	310	600	14.81
GCID Canal & Headworks	21,090	35	603	14.86
Transmission Lines	16,095	40	402	10.20
Recreation	8,780	44	200	5.49

**Batch Plants Controlled Emission Factors<sup>a</sup>**

Sand Transfer <sup>d</sup>	0.000297	lb PM <sub>10</sub> /ton cement
Aggregate Transfer <sup>d</sup>	0.00099	lb PM <sub>10</sub> /ton cement
Cement Unloading to Storage Silo	0.00034	lb PM <sub>10</sub> /ton cement
Cement Supplement Unloading to Storage Silo	0.0049	lb PM <sub>10</sub> /ton cement
Weigh Hopper Loading <sup>d</sup>	0.00072	lb PM <sub>10</sub> /ton cement
Truck Loading <sup>c</sup>	0.016	lb PM <sub>10</sub> /ton cement
<b>Total</b>	<b>0.023</b>	<b>lb PM<sub>10</sub>/ton cement</b>

<sup>a</sup>Emission factors from AP-42, Section 11.12, June 2006

<sup>b</sup> The batch plants will have dust control equipment and was assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer.

Source for control efficiency: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

<sup>c</sup> It was assumed the truck loading process would also include dust controls. Therefore, the controlled truck loading emission factor was used.

<sup>d</sup> It was assumed the PM<sub>2.5</sub> emission factors would be the same as PM<sub>10</sub> except for the truck loading. The PM<sub>2.5</sub> truck loading emission factor was obtained from the EPA document, *Emission Factor Documentation for AP-42 Section 11.12 Concrete Batching, Table 18.5* (June 2006). Similar to PM<sub>10</sub>, it was assumed the process would also include dust controls so the controlled truck loading emission factor was used.

**Concrete Batch Plant Storage Pile PM10 Emissions**

Emission Factor: 1.7 lb PM<sub>10</sub>/acre/day

Assumed Storage Pile Area 0.5 acres/day

Source: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

Table 24A.A-12  
Construction Areas of Disturbance for Fugitive Dust Emissions Calculations

NODOS Disturbed Acres for Fugitive Dust Emission Calculations					
Project Feature (File Name: ProjFacilitiesParcelsAcreages_9-23-11.xls)	Alternative	County	Total Project Feature Acreage (acres)	PM10 Emissions (lbs)	Construction Duration (days)
<b>1.27 MAF Sites Reservoir</b>					
Alt A		Colusa Co	10,491.2	104,911.5	
		Glenn Co	1,600.3	16,002.9	
	Alt A	Total	<b>12,091.4</b>	120,914.4	2224
<b>1.81 MAF Sites Reservoir</b>					
Alts BC		Colusa Co	12,046.1	120,460.8	
		Glenn Co	2,106.1	21,060.7	
	Alts BC	Total	<b>14,152.2</b>	141,521.5	2224
<b>Golden Gates and Sites Dams</b>					
Alt A	Alt A	Total	<b>50.4</b>	504.0	2224
Alts BC	Alts BC	Total	<b>57.7</b>	577.0	2224
<b>6 Saddle Dams</b>					
Alt A		Colusa Co	0.0	-	
		Glenn Co	37.3	372.5	
	Alt A	Total	<b>37.3</b>	372.5	2224
<b>9 Saddle Dams</b>					
Alts BC		Colusa Co	4.2	42.4	
		Glenn Co	94.0	939.7	
	Alts BC	Total	<b>98.2</b>	982.1	2224
<b>Subtotal Sites Reservoir and Dams</b>	Alt A	Total	<b>12179.1</b>	<b>121,790.9</b>	<b>2224</b>
	Alts BC	Total	<b>14308.1</b>	<b>143,080.6</b>	<b>2224</b>
<b>5 Recreation Areas</b>					
Alts ABC		Colusa Co	879.2	8,792.2	
		Glenn Co	329.2	3,292.1	
	Alts ABC	Total	<b>1208.4</b>	12,084.3	731
<b>Road Relocations and South Bridge</b>					
A		Colusa Co	1025.6	10,256.2	
A		Glenn Co	270.3	2,703.3	
	Alt A	Total	<b>1296.0</b>	12,959.5	1403
BC		Colusa Co	1031.4	10,313.8	
BC		Glenn Co	271.6	2,715.8	
	Alts BC	Total	<b>1303.0</b>	13,029.6	1403
<b>Sites Pumping Generating Plant &amp; Electrical Switchyard</b>					
Alts ABC	Alts ABC		<b>5.30</b>	53.0	485
<b>Tunnel from Sites Pum Gen to Intake Outfall</b>					
Alts ABC	Alts ABC		<b>3.1</b>	30.6	485
<b>Sites Res Inlet Outlet Structure</b>					
Alts ABC	Alts ABC		<b>204.2</b>	2,042.2	485
<b>Field Office Maint Yard</b>					
Alts ABC	Alts ABC		<b>18.3</b>	183.4	485
<b>Existing Funks Reservoir Dredging</b>					
Alts ABC	Alts ABC	No PM - WET	<b>228.4</b>	No PM - WET	
<b>Holthouse Reservoir Complex</b>					
Alts ABC	Alts ABC		<b>456.3</b>	4,563.0	826
<b>GCID Canal Intake &amp; Headworks</b>					
& GCID Canal Connection to TRR			9.5	95.0	
Alts ABC			3.6	36.0	
	Alts ABC	Total	<b>13.10</b>	131.0	743
<b>TRR</b>	Alts ABC		<b>191.6</b>	1,916.2	487
<b>TRR PG Plant</b>	Alts ABC		<b>0.7</b>	6.5	1276
<b>TRR Easement</b>					
<b>&amp; TRR to Funks Cr Pipeline Easement</b>			386.9	3,868.9	
Alts ABC			20.6	205.6	
	Alts ABC	Total	<b>407.5</b>	4,074.5	549
<b>Delevan Transmission Line</b>					
Alt A	Alt A		<b>372.8</b>	3,727.8	367
Alt B	Alt B		<b>151.8</b>	1,518.2	367
Alt C	Alt C		<b>372.8</b>	3,727.6	367
<b>Delevan Pipeline Intake Facilities</b>					
<b>&amp; Delevan Pipeline Discharge Facility</b>			19.2	191.5	
Alts ABC			7.7	76.6	
	Alts ABC	Total	<b>26.8</b>	268.1	549
<b>Asphalt Plant</b>					
Alts ABC	Alts ABC		<b>15.0</b>	149.6	100
	Alt A	Total	<b>16,398.1</b>	163,980.6	
	Alt B	Total	<b>18,313.1</b>	183,130.8	
	Alt C	Total	<b>18,534.0</b>	185,340.2	



Table 24A.A-13  
Construction Emissions for Funks Reservoir Sediment Removal

**NODOS Construction Emissions Calculations for New Features for Alternative A**

**New Feature: Funks Reservoir Sediment Removal**

Emissions (pounds per day)					
NOx	PM10	PM2.5	ROG	CO	SOx
705	43	30	0	269	1

Details of these calculations are provided in the construction emission spreadsheets for Alternatives B and C by Project Feature (Table 24A.B-2 through Table 24A.B-8).

Table 24A.A-14  
Comparison of Concrete for Alternatives

**NODOS Comparison of Concrete for Alternatives**

			Alternative A	Alternative B & C	Ratio				
						For Dams	Total Sacks of Concrete		
							Alternative A	Alternative B & C	
Sites Dam	Cement Type III	SK	10,400	12,100	1.16	Sacks	43,600	80,000	
	Grout Cap	CY	3,300	3,800	1.15	CY	8,720	16,000	
Golden Gate Dam	Cement Type III	SK	19,400	29,000	1.49				
	Grout Cap	CY	6,700	10,000	1.49				
Saddle Dam 1	Slurry Wall	CY	2,030	-	-				
Saddle Dam 2	Slurry Wall	CY		2,000		CY - dams	23,630	39,600	
Saddle Dam 3	Cement Type III	SK	8,900	17,300	1.94	Total CY	32,350	55,600	1.72
	Grout Cap	CY	6,000	8,500	1.42				
Saddle Dam 4									
Saddle Dam 5	Cement Type III	SK	2,700	8,500	3.15				
	Grout Cap	CY	3,100	5,100	1.65				
Saddle Dam 6	Cement Type III	SK		1,100					
	Grout Cap	CY		1,200					
Saddle Dam 7	Cement Type III	SK		2,100					
	Grout Cap	CY		2,300					
Saddle Dam 8a	Cement Type III	SK	2,200	9,900	4.50				
	Grout Cap	CY	2,500	6,700	2.68				
Saddle Dam 9									
			67,230	119,600	1.78				
Inlet/Outlet Works	Tunnel-Reinforced	CY	3,000	3,000	1.00				
	Nonreinforced	CY	37,000	37,000	1.00				
	Contract Grouting	SK	3,000	3,000	1.00				
	Low Intake Mass Concrete	CY	20,000	20,000	1.00				
	Low Intake Structural Concete	CY	2,200	2,200	1.00				
	Low Intake precast Prestressed Concrete	CY	1,300	1,300	1.00				
	Cement	CWT	216,000	216,000	1.00				
Multi-Level Outwork	Tower Concrete	EA	2,750	3,250	1.18				
	Shaft Concrete	EA	950	950	1.00				
	Cement	CWT	22,000	22,000	1.00				
	Bridge Pier Concrete	CY	1,160	1,160	1.00				
	Bridge Light Weight Concrete	CY	215	248	1.15				
	Gate transition concrete	CY	392	5,000	12.76				
Access Road	Asphalt Concrete	Ton	1,900	1,900	1.00				
Sites P/G Plant	Asphalt Concrete	Ton	2,200	2,200	1.00				
	Structural Concrete	CY	102,000	91,800	0.90				
	Backfill Concrete	CY	5,400	4,860	0.90				
	Pneumatically Placed Mortar to 3 Inch Thick	SY	40,000	40,000	1.00				
	Cement	CWT	544,000	489,600	0.90				
Emergency Drawdown	Structural Concrete (includes cement)	CY	6,530	6,530	1.00				
Plant Access Road	Asphalt Concrete	TON	6,500	6,500	1.00				
Temporary Bypass	112 ft RCP	LF	6,300	6,300	1.00				
	Concrete for Canal Connections	CY	320	320	1.00				
New Check Structure	Reinforced Concrete	CY	380	380	1.00				
Holthouse	Rolled Compacted Concrete (RCC) Spillway	CY	48,888	48,888	1.00				
	Spillway Top & Sides	CY	9,710	9,710	1.00				
	Spillway Base Slab	CY	4,166	4,166	1.00				
TRR Pump / Gen Plant	Reinforced Concrete P/G Plant	CY	30,000	30,000	1.00				
TRR Pipeline	Reinforced Concrete Encasement and Liner	CY	2,000	2,000	1.00				
Delevan Pipeline	Reinforced Concrete Encasement and Liner	CY	4,000	4,000	1.00				
Sacramento River Project	Reinforced Concrete P/G Plant	CY							
			1,124,261	1,064,262					
<b>TOTAL:</b>			<b>1,191,491</b>	<b>1,183,862</b>					

Table 24A.A-14  
Comparison of Concrete for Alternatives

5 Sacks of 94# Type III cement in a CY

Alternative A - volume of concrete for Alternative A is less than Alternatives B and C for the dams  
Ratio of Volume for Alt B/C to A = 1.72  
Ratio of Volume for Alt A to Alt. B/C = 0.58

Alternative A

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	39,751	15,900,513	7,212
Pipelines - Delevans and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	49,852	25,565	10,225,965	4,638
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Transmission Lines	16,095	8,254	3,301,538	1,498
Recreation	8,780	4,503	1,801,026	817
	505,315	259,136	103,654,273	47,017

Alternatives B & C

Project Feature	Total Concrete Mass (tons)	Total Concrete (CY)	GHG Emissions (lbs)	GHG Emissions (mt)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	39,751	15,900,513	7,212
Pipelines - Delevans and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	85,951	44,077	17,630,974	7,997
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Transmission Lines	16,095	8,254	3,301,538	1,498
Recreation	8,780	4,503	1,801,026	817
	541,414	277,648	111,059,282	50,376

Table 24A.A-15  
Total GHG Emissions from Construction of Alternative A

**NODOS Total GHG Emissions from Construction of Alternative A**

**Total mtCO<sub>2</sub>e Emissions from Construction Related Activities**

<b>Emissions from Mobile Construction Equipment (From Table 24A. A-5)</b>	<b>Emissions From Concrete Production (See Table Below)</b>	<b>Emissions from Construction Electricity Usage/TBM (See calculations below)</b>	<b>Total Construction Related Emissions</b>
184,206	47,017	4,297	235,520

**Alternative A**

<b>Project Feature</b>	<b>Total Concrete Mass (tons)</b>	<b>Total Concrete (CY)</b>	<b>GHG Emissions (lbs)</b>	<b>GHG Emissions (mt)</b>
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	39,751	15,900,513	7,212
Pipelines - Delevan and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	49,852	25,565	10,225,965	4,638
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Transmission Lines	16,095	8,254	3,301,538	1,498
Recreation	8,780	4,503	1,801,026	817
	505,315	259,136	103,654,273	47,017

**Tunnel Boring Machine Calculations**

TBM will operate for 200 days, 24 hours per day.

About 14 hours per day at max of 6,000 HP = 4476 kw\*14 hrs = 62,664 KWH

About 10 hours per day at 1200 HP = 896 kw\*10 hrs = 8960 KWH

71,624 KWh per day \* 200 days = 14,324,800 KWh total (14,324.8 MWh)

[14,324.8 MWh \\* .300 mtCO<sub>2</sub>e/MWh \(from eGrid 2012 version 1.0 2009 data CAMX subregion Total Output Emissions Rate http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1\\_0\\_year09\\_SummaryTables.pdf\)](http://www.epa.gov/cleanenergy/documents/egridzips/eGRID2012V1_0_year09_SummaryTables.pdf)

= 4,297 mtCO<sub>2</sub>e total for TBM use.

## **Emissions from Construction of Alternatives B and C**

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Table 24A.B-1  
Construction Emissions for Alternatives B and C - Emission Summaries by Construction Year for Criteria Pollutants

**NODOS Construction Emissions for Alternatives B and C**

**Average Daily Emission Rates for Criteria Pollutants by Year for Construction of Alternatives B and C**

Construction Year	Emissions (pounds per day)					
	NOx	PM10	PM2.5	ROG	CO	SOx
2013	<b>2,171</b>	<b>344</b>	124	<b>247</b>	833	3
2014	<b>4,487</b>	<b>860</b>	274	<b>508</b>	1,749	6
2015	<b>4,012</b>	<b>765</b>	246	<b>455</b>	1,565	5
2016	<b>4,061</b>	<b>770</b>	250	<b>460</b>	1,593	5
2017	<b>2,286</b>	<b>528</b>	153	<b>257</b>	920	3
2018	<b>990</b>	<b>319</b>	83	109	412	1
2019	<b>990</b>	<b>319</b>	83	109	412	1
2020	<b>892</b>	<b>298</b>	76	98	360	1
2021	98	21	8	11	52	0
Significance Threshold (lb/day)	137	137	n/a	137	n/a	n/a

Notes:

1. The average daily construction emission rates in lb/day for each construction year are the sum of the average daily emission rates estimated for each of the project features that would be constructed in the indicated construction year.
2. Bolded values indicate an exceedance of the significance threshold.
3. Significance Threshold is from TCAPCD Level C: Greater than 137 pounds per day of emissions. If emissions from a project would exceed the Level C thresholds, mitigation measures (BAMMs and SMMs), including off-site mitigation measures following the guidelines, may be required to reduce the overall air quality impacts of the project to a level of insignificance (TCAPCD 2009).

Table 24A.B-2  
Construction NO<sub>x</sub> Emissions for Alternatives B and C by Project Feature

NODOS  
Construction NO<sub>x</sub>  
Emissions  
Alternative B/C

Equipment	NO <sub>x</sub> Emissions (pounds)												Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	Periodic
Backhoe	0	0	0	0	0	0	0	0	0	6,704	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	2,909	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	439	0	0
Bulldozer	873	23,241	31,779	84,180	31,779	372,344	48,009	483,910	7,611	266,505	3,273	3,164	36,443
Compactor	50	21	63	293	63	250	0	4,822	49	0	0	0	0
Concrete Pumper	0	0	49	0	49	90	144	954	0	131	0	0	0
Concrete Truck	2,784	0	7,425	1,481	7,425	3,141	18,384	11,566	0	40,088	2,070	1,178	0
Crane	0	0	1,988	14,907	1,988	0	3,478	0	0	9,938	1,153	0	0
Dump Truck	13,708	0	22,311	154,747	22,311	143	10,709	14,814	2,195	120,924	4,212	8,460	0
Excavator	0	0	0	3,569	0	0	0	0	0	232	518	0	0
Fuel Truck	5,979	3,302	5,944	17,260	5,944	10,174	9,852	63,327	1,660	20,097	3,623	5,569	2,981
Forklift	0	591	1,689	6,335	1,689	249	2,154	376	0	0	490	511	0
Generator	1,171	0	781	4,377	781	165	1,501	608	0	3,753	218	248	0
Grader	0	369	2,237	5,222	2,237	4,451	6,396	85,827	1,163	23,528	0	313	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	1,154	914	751	8,018	751	920	2,404	21,415	246	7,423	349	950	0
Off-road Truck	0	27,130	0	0	0	26,594	0	496,903	0	81,389	0	0	0
Paver	276	167	0	0	0	0	0	0	42	668	0	184	0
Pile Driver	0	0	0	0	0	427	0	9,800	0	0	0	0	0
Roller	412	0	0	0	0	0	0	0	62	5,779	0	312	0
Scissor Lift	0	0	0	0	0	0	183	0	0	0	0	0	0
Scraper	3,900	18,425	32,922	388,118	32,922	323,855	87,322	192,165	4,154	246,876	0	0	75,510
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	1,543	1,619	3,508	7,280	3,508	17,164	2,650	53,420	1,438	16,953	437	1,084	2,514
Welding Truck	0	0	0	2,522	0	0	741	0	0	0	0	0	0
<b>Vehicles</b>													
Highway Truck	4,269	4,395	11,050	40,898	11,050	28,304	24,537	295,393	0	31,462	4,159	2,876	100
Personnel Vehicles	308	397	1,841	478	1,841	2,124	409	6,958	501	1,623	100	251	91
Unpaved roads	560	685	1,104	4,495	1,104	2,360	1,683	22,738	106	5,741	540	380	139
<b>Total Emissions (lbs)</b>	<b>36,988</b>	<b>81,254</b>	<b>125,441</b>	<b>744,180</b>	<b>125,441</b>	<b>792,755</b>	<b>220,558</b>	<b>1,764,996</b>	<b>19,228</b>	<b>889,816</b>	<b>21,580</b>	<b>28,388</b>	<b>117,779</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167
Emissions (lb/day)	49.8	166.8	98.3	1355.5	98.3	959.8	454.8	793.6	13.7	634.2	58.8	38.8	705.3

Daily Emissions  
(lb/day) in Year

2013	49.8	
2014	49.8	166.8
2015	49.8	166.8
2016		166.8

	1355.5	
	1355.5	
	1355.5	98.3
2017	1355.5	98.3
2018		98.3
2019	98.3	98.3
2020	98.3	
2021	98.3	
2022		

	959.8	454.8
	959.8	454.8
	959.8	
	959.8	
		793.6
		793.6
		793.6
		793.6
		793.6
		793.6

	13.7	634.2	58.8
	13.7	634.2	58.8
	13.7	634.2	
	13.7	634.2	
			38.8
			38.8
			38.8

Total lb/day NO <sub>x</sub> for Features Constructed In the Indicated Year		Year
2,171.02		2013
4,487.00		2014
4,012.27		2015
4,060.80		2016
2,286.27		2017
990.23		2018
990.23		2019
891.92		2020
98.31		2021
-		2022

Table 24A.B-3  
Construction PM10 Emissions for Alternatives B and C by Project Feature

NODOS  
Construction  
PM10 Emissions  
Alternative B/C

Equipment	PM10 Emissions (pounds)												Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	
													Periodic
Backhoe	0	0	0	0	0	0	0	0	0	561	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	171	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	37	0	0
Bulldozer	36	964	1,318	3,492	1,318	15,445	1,992	20,073	316	11,055	136	131	1,512
Compactor	2	1	2	11	2	10	0	187	2	0	0	0	0
Concrete Pumper	0	0	2	0	2	4	6	43	0	6	0	0	0
Concrete Truck	99	0	263	52	263	111	661	410	0	1,419	73	42	0
Crane	0	0	70	524	70	0	122	0	0	349	40	0	0
Dump Truck	485	0	790	5,479	790	5	379	525	78	4,282	149	300	0
Excavator	0	0	0	204	0	0	0	0	0	13	30	0	0
Fuel Truck	212	117	210	611	210	360	349	2,242	59	712	128	197	106
Forklift	0	34	97	364	97	14	124	22	0	0	28	29	0
Generator	91	0	60	339	60	13	116	47	0	291	17	19	0
Grader	0	21	126	294	126	251	360	4,832	65	1,325	0	18	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	101	80	66	699	66	80	210	1,867	21	647	30	83	0
Off-road Truck	0	961	0	0	0	942	0	17,594	0	2,882	0	0	0
Paver	24	15	0	0	0	0	0	0	4	58	0	16	0
Pile Driver	0	0	0	0	0	28	0	638	0	0	0	0	0
Roller	35	0	0	0	0	0	0	0	5	493	0	27	0
Scissor Lift	0	0	0	0	0	0	15	0	0	0	0	0	0
Scraper	151	715	1,277	15,056	1,277	12,563	3,387	7,455	161	9,577	0	0	2,929
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	51	54	117	242	117	570	88	1,774	48	563	15	36	84
Welding Truck	0	0	0	236	0	0	69	0	0	0	0	0	0
<b>Vehicles</b>													
Highway Truck	202	208	523	1,935	523	1,339	1,161	13,974	0	1,488	197	136	5
Personnel Vehicles	456	587	2,726	708	2,726	3,145	605	10,302	742	2,404	147	371	134
Unpaved Roads	9,617	11,752	18,951	77,154	18,951	40,512	28,895	390,276	1,826	98,545	9,273	6,522	2,391
<b>Fugitive PM Sources</b>													
Concrete Batch Plant	15	0	10	10	10	10	10	10	0	15	10	5	0
Disturbed Areas	131	1,916	268	4,075	7	4,563	2,309	143,081		13,179	3,728	12,084	
<b>Total Emissions (lbs)</b>	<b>11,707</b>	<b>17,423</b>	<b>26,876</b>	<b>111,485</b>	<b>26,615</b>	<b>79,965</b>	<b>40,849</b>	<b>615,352</b>	<b>3,326</b>	<b>149,864</b>	<b>14,038</b>	<b>20,187</b>	<b>7,160</b>

Highway truck and personnel vehicle emissions include paved road dust emissions.

The unpaved road emissions include fugitive dust from travel over unpaved roads.

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167
Emissions (lb/day)	15.8	35.8	21.1	203.1	20.9	96.8	84.2	276.7	2.4	106.8	38.3	27.6	42.9

Daily Emissions  
(lb/day) in Year

2013	15.8					96.8	84.2		2.4	106.8	38.3		
2014	15.8	35.8		203.1		96.8	84.2	276.7	2.4	106.8	38.3		
2015	15.8	35.8		203.1	20.9	96.8		276.7	2.4	106.8		27.6	
2016		35.8		203.1	20.9			276.7	2.4	106.8		27.6	
2017					20.9			276.7					
2018			21.1		20.9			276.7					
2019			21.1		20.9			276.7					
2020			21.1					276.7					
2021			21.1										
2022													

Total lb/day PM10 for Features Constructed In the Indicated Year	Year
344.23	2013
859.76	2014
764.90	2015
770.00	2016
528.23	2017
318.61	2018
318.61	2019
297.75	2020
21.06	2021
-	2022



Table 24A.B-4  
Construction PM2.5 Emissions for Alternatives B and C by Project Feature

NODOS  
Construction PM2.5  
Emissions  
Alternative B/C

Equipment	PM2.5 Emissions (pounds)													Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Hothouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	Periodic	
Backhoe	0	0	0	0	0	0	0	0	0	561	0	0	0	
Bobcat	0	0	0	0	0	0	0	0	0	0	0	171	0	
Boom Truck	0	0	0	0	0	0	0	0	0	0	37	0	0	
Bulldozer	36	964	1,318	3,492	1,318	15,445	1,992	20,073	316	11,055	136	131	1,512	
Compactor	2	1	2	11	2	10	0	187	2	0	0	0	0	
Concrete Pumper	0	0	2	0	2	4	6	43	0	6	0	0	0	
Concrete Truck	99	0	263	52	263	111	651	410	0	1,419	73	42	0	
Crane	0	0	70	524	70	0	122	0	0	349	40	0	0	
Dump Truck	485	0	790	5,479	790	5	379	525	78	4,282	149	300	0	
Excavator	0	0	0	204	0	0	0	0	0	13	30	0	0	
Fuel Truck	212	117	210	611	210	360	349	2,242	59	712	128	197	106	
Forklift	0	34	97	364	97	14	124	22	0	0	28	29	0	
Generator	91	0	60	339	60	13	116	47	0	291	17	19	0	
Grader	0	21	126	294	126	251	360	4,832	65	1,325	0	18	0	
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	
Loader	101	80	66	699	66	80	210	1,867	21	647	30	83	0	
Off-road Truck	0	961	0	0	0	942	0	17,594	0	2,882	0	0	0	
Paver	24	15	0	0	0	0	0	0	4	58	0	16	0	
Pile Driver	0	0	0	0	0	28	0	638	0	0	0	0	0	
Roller	35	0	0	0	0	0	0	0	5	493	0	27	0	
Scissor Lift	0	0	0	0	0	0	15	0	0	0	0	0	0	
Scraper	151	715	1,277	15,056	1,277	12,563	3,387	7,455	161	9,577	0	0	2,929	
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0	
Water Trucks	51	54	117	242	117	570	88	1,774	48	563	15	36	84	
Welding Truck	0	0	0	236	0	0	69	0	0	0	0	0	0	
<b>Vehicles</b>														
Highway Truck	202	208	523	1,935	523	1,339	1,161	13,974	0	1,488	197	136	5	
Personnel Vehicles	456	587	2,726	708	2,726	3,145	605	10,302	742	2,404	147	371	134	
Unpaved Roads	977	1,194	1,926	7,841	1,926	4,117	2,937	39,663	186	10,015	942	663	243	
<b>Fugitive PM Sources</b>														
Concrete Batch Plant	15	0	10	10	10	10	10	10	0	15	10	5	0	
Disturbed Areas	27	399	56	847	1	949	480	29,761	0	2,741	775	2,514		
<b>Total Emissions (lbs)</b>	<b>2,964</b>	<b>5,348</b>	<b>9,639</b>	<b>38,945</b>	<b>9,585</b>	<b>39,956</b>	<b>13,062</b>	<b>151,418</b>	<b>1,686</b>	<b>50,896</b>	<b>2,755</b>	<b>4,757</b>	<b>5,012</b>	

Highway truck and personnel vehicle emissions include paved road dust emissions.  
The unpaved road emissions include fugitive dust from travel over unpaved roads.  
PM<sub>2.5</sub> fugitive dust emissions were calculated following the SCAQMD Particulate Matter (PM) 2.5 Significance

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167
Emissions (lb/day)	4.0	11.0	7.6	70.9	7.5	48.4	26.9	68.1	1.2	36.3	7.5	6.5	30.0

Daily Emissions  
(lb/day) in Year

2013	4.0					48.4	26.9		1.2	36.3	7.5		
2014	4.0	11.0		70.9		48.4	26.9	68.1	1.2	36.3	7.5		
2015	4.0			70.9		48.4		68.1	1.2	36.3		6.5	
2016		11.0		70.9	7.5	48.4		68.1	1.2	36.3		6.5	
2017				70.9	7.5			68.1				6.5	
2018			7.6		7.5			68.1					
2019			7.6		7.5			68.1					
2020			7.6					68.1					
2021			7.6										
2022													

Total lb/day PM2.5 for Features Constructed In the Indicated Year	Year
124.28	2013
274.28	2014
246.35	2015
249.87	2016
153.04	2017
83.15	2018
83.15	2019
75.64	2020
7.55	2021
-	2022

Table 24A.B-5  
Construction CO<sub>2</sub> Emissions for Alternatives B and C by Project Feature

NODOS Construction  
CO<sub>2</sub> Emissions  
Alternative B/C

Equipment	CO <sub>2</sub> Emissions (pounds)											
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Siles Dumps/ice Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities
Backhoe	0	0	0	0	0	0	0	0	0	418,214	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	154,601
Boom Truck	0	0	0	0	0	0	0	0	0	0	0	0
Bulldozer	50,007	1,331,438	1,820,570	4,822,556	1,820,570	21,331,137	2,750,388	27,722,665	435,999	15,267,781	187,526	181,276
Compactor	2,949	1,224	3,710	17,325	3,710	14,765	0	284,728	2,894	0	0	0
Concrete Pumper	0	0	3,681	0	3,681	6,795	10,830	71,853	0	9,910	0	0
Concrete Truck	242,155	0	645,747	128,839	645,747	273,201	1,598,845	1,005,876	0	3,486,414	180,064	102,450
Crane	0	0	96,455	723,414	96,455	0	168,797	0	0	482,276	55,944	0
Dump Truck	1,192,149	0	1,940,346	13,458,243	1,940,346	12,418	931,366	1,288,390	190,930	10,516,678	366,337	735,779
Excavator	0	0	0	255,861	0	0	0	0	0	16,631	37,100	0
Fuel Truck	520,013	287,171	516,908	1,501,052	516,908	884,798	856,857	5,507,479	144,362	1,747,864	315,112	484,310
Forklift	0	23,542	67,264	252,240	67,264	9,921	85,762	14,966	0	0	19,507	20,347
Generator	89,983	0	59,989	336,284	59,989	12,690	115,363	46,722	0	288,408	16,728	19,035
Grader	0	24,945	151,182	353,009	151,182	300,851	432,379	5,801,591	78,614	1,590,430	0	21,165
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0
Loader	61,081	48,355	39,766	424,383	39,766	48,674	127,251	1,133,490	13,043	392,888	18,451	50,264
Off-road Truck	0	2,359,461	0	0	0	2,312,893	0	43,215,396	0	7,078,384	0	0
Paver	14,157	8,580	0	0	0	0	0	0	2,145	34,321	0	9,438
Pile Driver	0	0	0	0	0	49,164	0	1,129,044	0	0	0	0
Roller	21,802	0	0	0	0	0	0	0	3,303	305,557	0	16,517
Scissor Lift	0	0	0	0	0	0	9,022	0	0	0	0	0
Scraper	319,366	1,508,890	2,696,100	31,783,891	2,696,100	26,521,289	7,151,028	15,736,891	340,195	20,217,276	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	207,705	217,837	472,148	979,758	472,148	2,310,082	356,644	7,189,623	193,520	2,281,712	58,765	145,900
Welding Truck	0	0	0	116,809	0	0	34,342	0	0	0	0	0
<b>Vehicles</b>												
Highway Truck	959,035	987,242	2,482,208	9,186,992	2,482,208	6,357,838	5,511,631	66,353,944	0	7,067,242	934,213	645,938
Personnel Vehicles	1,157,796	1,491,588	6,924,960	1,799,482	6,924,960	7,989,098	1,537,584	26,171,228	1,884,703	6,106,437	374,684	942,701
Unpaved roads	122,701	149,943	241,797	984,415	241,797	516,902	368,676	4,979,592	23,293	1,257,346	118,318	83,213
<b>Total Emissions (lbs)</b>	<b>4,960,900</b>	<b>8,440,218</b>	<b>18,162,831</b>	<b>67,124,552</b>	<b>18,162,831</b>	<b>68,952,518</b>	<b>22,046,767</b>	<b>207,653,578</b>	<b>3,313,001</b>	<b>78,565,769</b>	<b>2,704,401</b>	<b>3,612,935</b>
<b>Total Emissions (metric tons)</b>	<b>2,250</b>	<b>3,828</b>	<b>8,239</b>	<b>30,447</b>	<b>8,239</b>	<b>31,276</b>	<b>10,000</b>	<b>94,190</b>	<b>1,503</b>	<b>35,637</b>	<b>1,227</b>	<b>1,639</b>
<b>CONSTRUCTION</b>												
<b>TOTAL (metric tons)</b>	<b>228,475</b>											
<b>Construction Duration (days)</b>												
Emissions (lb/day)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731
	6676.9	17331.0	14234.2	122266.9	14234.2	83477.6	45457.3	93369.4	2361.4	55998.4	7368.9	4942.5

Ave. Annual Emissions  
(mt/yr) in Year

2013	750.1					7819.1	5000.1		375.7	8909.2	613.3	
2014	750.1	1276.1		7611.8		7819.1	5000.1	13455.7	375.7	8909.2	613.3	
2015	750.1	1276.1		7611.8		7819.1		13455.7	375.7	8909.2		546.3
2016		1276.1		7611.8	2059.6	7819.1		13455.7	375.7	8909.2		546.3
2017				7611.8	2059.6			13455.7				
2018			2059.6		2059.6			13455.7				
2019			2059.6		2059.6			13455.7				
2020			2059.6					13455.7				
2021			2059.6									
2022												

Total mt/yr CO <sub>2</sub> for Features Constructed In the Indicated Year		Year
23,467.55		2013
45,811.24		2014
40,744.03		2015
42,053.59		2016
23,673.45		2017
17,575.01		2018
17,575.01		2019
15,515.37		2020
2,059.63		2021
-		2022
228,474.89		CONSTRUCTION TOTAL (metric tons)

Table 24A.B-6  
Construction ROG Emissions for Alternatives B and C by Project Feature

NODOS  
Construction ROG  
Emissions  
Alternative B/C

Equipment	ROG Emissions (pounds)												Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	
													Periodic
Backhoe	0	0	0	0	0	0	0	0	0	1,019	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	392	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	139	0	0
Bulldozer	103	2,730	3,732	9,887	3,732	43,730	5,638	56,833	894	31,300	384	372	3
Compactor	8	3	10	47	10	40	0	769	8	0	0	0	0
Concrete Pumper	0	0	8	0	8	14	23	151	0	21	0	0	0
Concrete Truck	338	0	900	180	900	381	2,229	1,402	0	4,860	251	143	0
Crane	0	0	208	1,559	208	0	364	0	0	1,039	121	0	0
Dump Truck	1,662	0	2,705	18,762	2,705	17	1,298	1,796	266	14,661	511	1,026	0
Excavator	0	0	0	482	0	0	0	0	0	31	70	0	0
Fuel Truck	725	400	721	2,093	721	1,234	1,195	7,678	201	2,437	439	675	2
Forklift	0	79	226	848	226	33	288	50	0	0	66	68	0
Generator	169	0	113	633	113	24	217	88	0	543	31	36	0
Grader	0	48	293	684	293	583	837	11,236	152	3,080	0	41	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	186	147	121	1,293	121	148	388	3,454	40	1,197	56	153	0
Off-road Truck	0	3,289	0	0	0	3,224	0	60,247	0	9,868	0	0	0
Paver	46	28	0	0	0	0	0	0	7	111	0	30	0
Pile Driver	0	0	0	0	0	38	0	871	0	0	0	0	0
Roller	65	0	0	0	0	0	0	0	10	911	0	49	0
Scissor Lift	0	0	0	0	0	0	58	0	0	0	0	0	0
Scraper	439	2,074	3,706	43,693	3,706	36,459	9,831	21,633	468	27,793	0	0	0
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	174	183	396	822	396	1,938	299	6,032	162	1,914	49	122	1
Welding Truck	0	0	0	959	0	0	282	0	0	0	0	0	0
<b>Vehicles</b>													
Highway Truck	242	249	626	2,317	626	1,604	1,390	16,735	0	1,782	236	163	6
Personnel Vehicles	42	54	250	65	250	288	56	945	68	220	14	34	12
Unpaved roads	67	81	131	535	131	281	200	2,705	13	683	64	45	17
<b>Total Emissions (lbs)</b>	<b>4,265</b>	<b>9,366</b>	<b>14,147</b>	<b>84,858</b>	<b>14,147</b>	<b>90,036</b>	<b>24,593</b>	<b>192,627</b>	<b>2,289</b>	<b>103,472</b>	<b>2,431</b>	<b>3,350</b>	<b>41</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167
Emissions (lb/day)	5.7	19.2	11.1	154.6	11.1	109.0	50.7	86.6	1.6	73.8	6.6	4.6	0.2

Daily Emissions  
(lb/day) in Year

2013	5.7					109.0	50.7			1.6	73.8	6.6	
2014	5.7	19.2		154.6		109.0	50.7	86.6	1.6	73.8	6.6		
2015	5.7	19.2		154.6		109.0		86.6	1.6	73.8		4.6	
2016		19.2		154.6	11.1	109.0		86.6	1.6	73.8		4.6	
2017				154.6	11.1			86.6				4.6	
2018			11.1		11.1			86.6					108.79
2019			11.1		11.1			86.6					108.79
2020			11.1					86.6					97.70
2021			11.1										11.09
2022													-

Total lb/day ROG for Features Constructed In the Indicated Year	Year
247.45	2013
507.87	2014
455.12	2015
460.47	2016
256.85	2017
108.79	2018
108.79	2019
97.70	2020
11.09	2021
-	2022

Table 24A.B-7  
Construction SOx Emissions for Alternatives B and C by Project Feature

NODUS  
Construction SOx  
Emissions  
Alternative B/C

Equipment	SOx Emissions (pounds)													Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Holthouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	Periodic	
Backhoe	0	0	0	0	0	0	0	0	0	8	0	0	0	
Bobcat	0	0	0	0	0	0	0	0	0	0	0	3	0	
Boom Truck	0	0	0	0	0	0	0	0	0	0	1	0	0	
Bulldozer	1	20	27	72	27	318	41	413	6	227	3	3	31	
Compactor	0	0	0	1	0	0	0	9	0	0	0	0	0	
Concrete Pumper	0	0	0	0	0	0	0	2	0	0	0	0	0	
Concrete Truck	4	0	10	2	10	4	25	16	0	54	3	2	0	
Crane	0	0	2	18	2	0	4	0	0	12	1	0	0	
Dump Truck	18	0	30	208	30	0	14	20	3	162	6	11	0	
Excavator	0	0	0	5	0	0	0	0	0	0	1	0	0	
Fuel Truck	8	4	8	23	8	14	13	85	2	27	5	7	4	
Forklift	0	1	2	9	2	0	3	1	0	0	1	1	0	
Generator	1	0	1	5	1	0	2	1	0	4	0	0	0	
Grader	0	0	3	6	3	5	7	100	1	28	0	0	0	
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0	
Loader	1	1	1	8	1	1	2	22	0	8	0	1	0	
Off-road Truck	0	36	0	0	0	36	0	666	0	109	0	0	0	
Paver	0	0	0	0	0	0	0	0	0	1	0	0	0	
Pile Driver	0	0	0	0	0	1	0	16	0	0	0	0	0	
Roller	0	0	0	0	0	0	0	0	0	6	0	0	0	
Scissor Lift	0	0	0	0	0	0	0	0	0	0	0	0	0	
Scraper	4	18	33	388	33	324	87	192	4	247	0	0	75	
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0	
Water Trucks	3	3	6	12	6	29	4	89	2	28	1	2	4	
Welding Truck	0	0	0	3	0	0	1	0	0	0	0	0	0	
<b>Vehicles</b>														
Highway Truck	9	9	23	85	23	59	51	617	0	66	9	6	0	
Personnel Vehicles	11	15	68	18	68	79	15	258	19	60	4	9	3	
Unpaved roads	1	1	2	9	2	5	4	48	0	12	1	1	0	
<b>Total Emissions (lbs)</b>	<b>62</b>	<b>109</b>	<b>217</b>	<b>872</b>	<b>217</b>	<b>875</b>	<b>275</b>	<b>2,554</b>	<b>39</b>	<b>1,059</b>	<b>34</b>	<b>47</b>	<b>119</b>	
Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167	
Emissions (lb/day)	0.1	0.2	0.2	1.6	0.2	1.1	0.6	1.1	0.0	0.8	0.1	0.1	0.7	

Daily Emissions  
(lb/day) in Year

2013	0.1					1.1	0.6		0.0	0.8	0.1		
2014	0.1	0.2		1.6		1.1	0.6	1.1	0.0	0.8	0.1		
2015	0.1	0.2		1.6		1.1		1.1	0.0	0.8		0.1	
2016		0.2		1.6	0.2	1.1		1.1	0.0	0.8		0.1	
2017				1.6	0.2			1.1				0.1	
2018			0.2		0.2			1.1					
2019			0.2		0.2			1.1					
2020			0.2					1.1					
2021			0.2										
2022													

Total lb/day SOx for Features Constructed In the Indicated Year	Year
2.59	2013
5.55	2014
4.95	2015
5.04	2016
2.97	2017
1.49	2018
1.49	2019
1.32	2020
0.17	2021
-	2022

Table 24A.B-8  
Construction CO Emissions for Alternatives B and C by Project Feature

NODOS  
Construction CO  
Emissions  
Alternative B/C

Equipment	CO Emissions (pounds)												Funks Reservoirs Sediment Removal
	GCID Canal Intake & Headworks	TRR	Delevan Intake & P/G Plant	TRR & Delevan Pipelines	TRR Pumping Plant	New Hothouse Reservoir	Inlet/Outlet Structure, Tunnel, Sites Pumping Plant	Dams and Sites Inundation	Gravel Roads	Paved Roads & Bridge	Substations & Transmission Lines	Recreation Facilities	
													Periodic
Backhoe	0	0	0	0	0	0	0	0	0	5,181	0	0	0
Bobcat	0	0	0	0	0	0	0	0	0	0	0	1,805	0
Boom Truck	0	0	0	0	0	0	0	0	0	0	417	0	0
Bulldozer	228	6,082	8,316	22,029	8,316	97,440	12,664	126,636	1,992	69,743	857	828	9,537
Compactor	42	17	53	246	53	209	0	4,038	41	0	0	0	0
Concrete Pumper	0	0	40	0	40	74	118	784	0	108	0	0	0
Concrete Truck	991	0	2,643	527	2,643	1,118	6,544	4,117	0	14,269	737	419	0
Crane	0	0	589	4,416	589	0	1,030	0	0	2,944	341	0	0
Dump Truck	4,879	0	7,942	55,083	7,942	51	3,812	5,273	781	43,043	1,499	3,011	0
Excavator	0	0	0	2,664	0	0	0	0	0	173	386	0	0
Fuel Truck	2,128	1,175	2,116	6,144	2,116	3,621	3,507	22,541	591	7,154	1,290	1,982	1,061
Forklift	0	462	1,320	4,950	1,320	195	1,683	294	0	0	383	399	0
Generator	763	0	508	2,850	508	108	978	396	0	2,444	142	161	0
Grader	0	242	1,467	3,427	1,467	2,920	4,197	56,315	763	15,438	0	205	0
Highway Truck	0	0	0	0	0	0	0	0	0	0	0	0	0
Loader	796	631	519	5,533	519	635	1,659	14,779	170	5,123	241	655	0
Off-road Truck	0	9,657	0	0	0	9,466	0	176,875	0	28,971	0	0	0
Paver	167	101	0	0	0	0	0	0	25	404	0	111	0
Pile Driver	0	0	0	0	0	399	0	9,160	0	0	0	0	0
Roller	268	0	0	0	0	0	0	0	41	3,755	0	203	0
Scissor Lift	0	0	0	0	0	0	174	0	0	0	0	0	0
Scraper	1,670	7,888	14,095	166,159	14,095	138,647	37,384	82,269	1,778	105,691	0	0	32,327
Tunnel Boring Machine	0	0	0	0	0	0	0	0	0	0	0	0	0
Water Trucks	479	502	1,088	2,257	1,088	5,322	822	16,565	446	5,257	135	336	780
Welding Truck	0	0	0	2,723	0	0	801	0	0	0	0	0	0
<b>Vehicles</b>													
Highway Truck	1,091	1,123	2,825	10,455	2,825	7,235	6,272	75,509	0	8,042	1,063	735	26
Personnel Vehicles	3,675	4,734	21,979	5,711	21,979	25,357	4,880	83,066	5,982	19,381	1,189	2,992	1,082
Unpaved roads	188	230	371	1,511	371	793	566	7,644	36	1,930	182	128	47
<b>Total Emissions (lbs)</b>	<b>17,365</b>	<b>32,845</b>	<b>65,870</b>	<b>296,685</b>	<b>65,870</b>	<b>293,591</b>	<b>86,990</b>	<b>686,261</b>	<b>12,646</b>	<b>339,052</b>	<b>8,862</b>	<b>13,972</b>	<b>44,859</b>

Construction Duration (days)	743	487	1276	549	1276	826	485	2224	1403	1403	367	731	167
Emissions (lb/day)	23.4	67.4	51.6	540.4	51.6	355.4	179.4	308.6	9.0	241.7	24.1	19.1	268.6

Daily Emissions  
(lb/day) in Year

2013	23.4					355.4	179.4		9.0	241.7	24.1	
2014	23.4	67.4		540.4		355.4	179.4	308.6	9.0	241.7	24.1	
2015	23.4	67.4		540.4		355.4		308.6	9.0	241.7		19.1
2016		67.4		540.4	51.6	355.4		308.6	9.0	241.7		19.1
2017				540.4	51.6			308.6				19.1
2018			51.6		51.6			308.6				
2019			51.6		51.6			308.6				
2020			51.6					308.6				
2021			51.6									
2022												

Total lb/day CO for Features Constructed In the Indicated Year		Year
832.99		2013
1,749.42		2014
1,565.02		2015
1,593.27		2016
919.72		2017
411.82		2018
411.82		2019
360.19		2020
51.62		2021
-		2022

Table 24A.B-9  
Construction Equipment Emission Factors

**NODOS Construction - Emission Factors**

**Construction Equipment Emission Factors**

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.55	75	5.015	0.42	312.846	0.762	0.006	3.876	0.42
Bobcat	Other General Industrial	0.51	150	5.458	0.32	290.093	0.735	0.006	3.386	0.32
Boom Truck	Aerial Lift	0.46	34	5.307	0.443	261.653	1.676	0.007	5.042	0.443
Bulldozer	Rubber Tired Dozer	0.59	358	5.858	0.243	335.598	0.688	0.005	1.533	0.243
Compactor	Plate Compactor	0.43	8	4.142	0.161	244.589	0.661	0.008	3.469	0.161
Compressor	Air Compressor	0.48	78	5.978	0.543	273.029				0.543
Concrete Pumper	Cement and Mortar Mixer	0.56	9	4.223	0.191	318.534	0.669	0.008	3.469	0.191
Concrete Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Crane	Crane	0.43	208	5.04	0.177	244.589	0.527	0.006	1.493	0.177
Dump Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Excavator	Excavator	0.57	157	4.523	0.259	324.222	0.611	0.006	3.376	0.259
Fuel Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Forklift	Forklift	0.30	149	4.286	0.246	170.643	0.574	0.006	3.349	0.246
Generator	Generator set	0.74	84	5.478	0.424	420.920	0.792	0.006	3.567	0.424
Grader	Grader	0.61	162	5.133	0.289	346.974	0.672	0.006	3.368	0.289
Highway Truck	Estimated with EMFAC2007 emission factors and by assuming 10 one-way trips per equipment day (5 round trips)									
Loader	Rubber Tired Loader	0.54	87	5.803	0.506	307.158	0.936	0.006	4.005	0.506
Off-road Truck	Off-Highway Truck	0.57	381	3.728	0.132	324.222	0.452	0.005	1.327	0.132
Paver	Paver	0.62	89	6.863	0.598	352.663	1.139	0.006	4.153	0.598
Pile Driver	Bore/Drill Rig	0.75	82	3.703	0.241	426.608	0.329	0.006	3.461	0.241
Roller	Roller	0.56	84	6.024	0.514	318.534	0.95	0.006	3.914	0.514
Scissor Lift	Aerial Lift	0.46	34	5.307	0.443	261.653	1.676	0.007	5.042	0.443
Scraper	Scraper	0.72	356	5.001	0.194	409.544	0.563	0.005	2.141	0.194
Tunnel Boring Machine	ASSUME ELECTRIC			0	0	0	0	0	0	0
Water Trucks	Water Truck	0.75	189	2.409	0.08	324.222	0.272	0.004	0.747	0.08
Welding Truck	Welder	0.45	46	5.526	0.517	255.965	2.101	0.007	5.967	0.517

1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (Environ, 2011). The CO2 emission factors are from Appendix I of the URBEMIS2007 for Windows Users Guide (2007).

2. The emission factors are for the year 2013.

3. It was assumed emissions from concrete trucks, fuel trucks, and dump trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the construction area, for example, concrete trucks making trips from an onsite concrete batch plant to the pour location.

**Vehicle Emission Factors**

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	1.2237	0.0001	0.0000	0.0030	0.0001
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0002	0.0001	0.6717	0.0000	0.0000	0.0021	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0261	0.0010	5.7230	0.0031	0.0001	0.0088	0.0008
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0179	0.0006	4.0296	0.0010	0.0000	0.0046	0.0005
Vehicle	Vehicle Type in EMFAC2007	Emission Factors (g/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.111	0.04	555.078	0.03	0.005	1.346	0.025
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.081	0.028	304.669	0.011	0.003	0.967	0.014
Truck at 15 mph	Heavy-Heavy Duty Diesel	11.854	0.45	2595.958	1.41	0.025	3.985	0.376
Truck at 35 mph	Heavy-Heavy Duty Diesel	8.137	0.293	1827.808	0.461	0.017	2.08	0.232

1. It was assumed that 'non-personnel' trips are diesel truck trips.

2. Emission factors from the California Air Resources Board's EMFAC 2007 model for the Colusa County portion of the Sacramento Valley Air Basin. It was assumed that diesel trucks would be ten years old or newer so the model year in EMFAC was changed to 2000 through 2013, rather than the default of 1969- 2013.

3. Truck age assumption based on the ARBStaff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014, December 2009.

4. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.

5. The PM10 and PM2.5 emission factors include tire and brake wear.

**Calculation of Paved Road Emission Factor**

Paved Roads emission factor from AP-42, Section 13.2.1: Paved Roads (1/11)

$$E = [k(sL)^{0.91}(W)^{1.02}]^{PM10}$$

where:

- k = 1.0 particle size multiplier, g/VMT [Table 13.2-1.1]
- sL = 0.03 road surface silt loading (g/m<sup>2</sup>) [Table 13.2.1-2]
- W = 2.2 vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (Environ, 2011)]
- E (PM10)<sup>PM</sup> = 0.092 g/VMT

**Calculation of Unpaved Road Emission Factor**

**PM10**

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)<sup>0.75</sup> x (average vehicle weight [tons] / 3)<sup>0.45</sup> x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	50
Emission Factor (lb/mile)	0.45

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Reference for Precipitation: WRCC, Hollister CA, <http://www.wrcc.dri.edu/cgi-bin/cliGCCIP.pl?ca4025>

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

**PM2.5**

Emission Factor [lb/mi] = 0.15 x (silt content [%] / 12)<sup>0.75</sup> x (average vehicle weight [tons] / 3)<sup>0.45</sup> x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	PM2.5
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	50
Emission Factor (lb/mile)	0.04

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road

Reference for Precipitation: WRCC, Hollister CA, <http://www.wrcc.dri.edu/cgi-bin/cliGCCIP.pl?ca4025>

The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

**Disturbed Land Fugitive Dust Emission Factor**

Emission Factor (lb/acre/day) 10 PM10  
From URBEMIS2007 construction phase mass site grading.  
Per URBEMIS2007 Appendix A, page A-6, the value assumes watering.

NODOS Construction

Table 24A.B-10  
Equipment and Workforce for Construction of Features for Alternatives B and C (2 pages)

Project Features: Notes from Project Description	GCID Canal Modification - Included in			GCID Canal Connection - Included in			GCID Canal & Headworks			TRR			Sac River (Delevan) Intake & P/G Plant			TRR & Delevan Pipelines			TRR Pumping Plant			Funks Reservoir Modification (REV -					
Constr. Schedule (7/12/11 Update)	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish			
	366	7/15/2014	7/15/2015				743	7/3/2013	7/15/2015	487	7/2/2014	10/30/2016	1276	5/15/2018	11/8/2021	Delevan:			1276	12/18/2015	6/19/2019	826	4/1/2013	7/9/2016			
Equipment	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day			
Asphalt Delivery Truck																											
Backhoe																											
Bobcat																											
Boom Truck																											
Bulldozer								1	32	10		1	852	10		1	3086	10		1	1165	10		1	13650	10	
Compactor								1	159	10		1	66	10		1	934	10		1	200	10		1	796	10	
Concrete Pumper																	1	104	10		1	104	10		1	192	10
Concrete Truck								1	156	10							1	416	10		1	416	10		1	176	10
Crane																	1	200	10		1	200	10				
Dump Truck								1	768	10							1	8670	10		1	1250	10		1	8	10
Excavator																	1	400	10								
Fuel Truck								1	335	10		1	185	10		1	333	10		1	333	10		1	570	10	
Forklift																	1	1500	10		1	400	10		1	59	10
Generator								1	156	10							1	583	10		1	104	10		1	22	10
Grader																	1	200	10		1	200	10		1	398	10
Highway Truck								1	680	10		1	700	10		1	1760	10		1	1760	10		1	4508	10	
Loader								1	192	10		1	152	10		1	125	10		1	125	10		1	153	10	
Off-road Truck																											
Paver								1	33	10		1	20	10											1	1490	10
Pile Driver/Drill Rig																											
Roller								1	66	10															1	85	10
Scissor Lift																											
Scraper								1	138	10		1	652	10		1	1165	10		1	1165	10		1	11460	10	
Tunnel Boring Machine																											
Water Trucks								1	205	10		1	215	10		1	466	10		1	466	10		1	2280	10	
Welding Truck																	1	1000	10								
Trips/Workforce	Total number of round trips	Average one way trip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Average one way trip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.			
	0	60	0	0	60	0	3400	70	29	3500	70	57	8800	70	101	32570	70	61	8800	70	101	22540	70	180			
	0	60		0	60		21547	80		27759	80		128876	80		33489	80		128876	80		148680	80				
	0	2		0	2		10720	2		13100	2		21125	2		86005	2		21125	2		45160	2				

Number of truck roundtrips per equipment day

5

Source: URS 2011.

NODOS Construction

Table 24A.B-10  
Equipment and Workforce for Construction of Features for Alternatives B and C (2 pages)

Inlet/Outlet Structure and Tunnel and			Dams and Sites Inundation			Gravel Roads			Paved Roads & Bridge			Substations & Transmission Lines			Recreation Facilities			Funks Reservoirs Sediment Removal			Electrical Transmission & Switchyard Features		
I/O - Emergency release. Tunnel - 4031 ft long, 30 ft diameter, concrete lined with steel in first 1000 ft, is			list of embankment volumes provided, need quarries for materials, access roads, batch plants, stream diversion.			25 miles of gravel roads			20 miles of paved roads, 1.6 mile bridge, asphalt batch plant, construction details in Section 2.6.1.3			clearing, grading, materials staging, substation pad			clearing, excavation, backfilling, roads, parking lot, utilities, boat ramp, revegetation			dredging/sediment removal from Funks Reservoir			electrical transmission and switchyard features		
Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish	Duration (Days)	Start	Finish
243 (VO)	1/1/2013	8/31/2013	885 (saddle)	7/2/2014	12/2/2016	1403	1/1/2013	11/3/2016	1403	1/1/2013	11/3/2016	367	6/29/2013	6/30/2014	731	1/2/2015	1/1/2017	167			365		
Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet 6/29/11)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)	Number of Hours of Use per Equipment Day	Enter "1" if Equipment Type is in Use	Total Number of Equipment Days of Use (Spreadsheet: Equipment for Sediment and Trans May 2012)	Number of Hours of Use per Equipment Day
									1	1470	10												
												1	240	10	1	316	10						
1	1760	10	1	17740	10	1	279	10	1	9770	10	1	120	10	1	116	10	1	1336	10	1	8	10
				15350	10	1	156	10															
1	306	10	1	2033	10				1	280	10										1	29	10
1	1030	10	1	648	10				1	2246	10	1	116	10	1	66	10				1	154	10
1	350	10							1	1000	10	1	116	10							1	474	10
1	600	10	1	830	10	1	123	10	1	6775	10	1	236	10	1	474	10				1	14	10
									1	26	10	1	58	10									
1	552	10	1	3548	10	1	93	10	1	1126	10	1	203	10	1	312	10	1	167	10	1	57	10
1	510	10	1	89	10							1	116	10	1	121	10				1	82	10
1	200	10	1	81	10				1	500	10	1	29	10	1	33	10						
1	572	10	1	7675	10	1	104	10		1	2104	10			1	28	10				1	40	10
1	3908	10	1	47048	10				1	5011	10	1	552	10	1	458	10	1	16	10	1	810	10
1	400	10	1	3563	10	1	41	10	1	1235	10	1	58	10	1	158	10				1	103	10
			1	27840	10					4560	10												
						1	5	10	1	80	10				1	22	10						
			1	1952	10					105											1	95	10
						1	10	10	1	925	10				1	50	10						
1	100	10																					
1	3090	10	1	6800	10	1	147	10	1	8736	10							1	2672	10			
1	200	24																					
1	352	10	1	7096	10	1	191	10	1	2252	10	1	58	10	1	144	10	1	334	10	1	101	10
1	294	10																					
Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.	Total number of round trips	Roundtrip distance (miles)	Maximum Daily Workforce Required For Const.
19540	70	59	235240	70	219	0	70		25055	70	81	3312	70	19	2290	70	24	80	70		4050	70	
28615	80		487056	80		35075	80		113643	80		6973	80		17544	80		6346	80	38	18615	80	51
32210	2		435060	2		2035	2		109850	2		10337	2		7270	2		2665	2		9730	2	



NODOS Construction Emissions

Table 24A.B-11  
Concrete Batch Plant PM10 Emissions

### Construction On-Site Concrete Batch Plant Emissions

Project Feature	Total Concrete Mass (tons)	Number of Days	Daily Rate (tons/day)	PM <sub>10</sub> Emissions (lb/day)
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	194	400	10.14
Pipelines - Delevans and TRR	11,100	28	396	10.07
Dams & Sites Inundation	85,951	215	400	10.14
TRR Pump Plant	55,500	139	399	10.13
Funks Reservoir Modification	23,773	59	403	10.22
Sacramento River Intake & P/G Plant	55,500	139	399	10.13
Paved Roads & Bridges	186,110	310	600	14.81
GCID Canal & Headworks	21,090	35	603	14.86
Transmission Lines	16,095	40	402	10.20
Recreation	8,780	44	200	5.49

#### Batch Plants Controlled Emission Factors<sup>a</sup>

Sand Transfer <sup>b</sup>	0.000297	lb PM <sub>10</sub> /ton cement
Aggregate Transfer <sup>b</sup>	0.00099	lb PM <sub>10</sub> /ton cement
Cement Unloading to Storage Silo	0.00034	lb PM <sub>10</sub> /ton cement
Cement Supplement Unloading to Storage Silo	0.0049	lb PM <sub>10</sub> /ton cement
Weigh Hopper Loading <sup>b</sup>	0.00072	lb PM <sub>10</sub> /ton cement
Truck Loading <sup>c</sup>	0.016	lb PM <sub>10</sub> /ton cement
<b>Total</b>	<b>0.023</b>	<b>lb PM<sub>10</sub>/ton cement</b>

<sup>a</sup>Emission factors from AP-42, Section 11.12, June 2006

<sup>b</sup> The batch plants will have dust control equipment and was assumed to control dust emissions with an efficiency of 70% during sand and aggregate transfer.

Source for control efficiency: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009

<sup>c</sup> It was assumed the truck loading process would also include dust controls. Therefore, the controlled truck loading emission factor was used.

<sup>d</sup> It was assumed the PM<sub>2.5</sub> emission factors would be the same as PM<sub>10</sub> except for the truck loading. The PM<sub>2.5</sub> truck loading emission factor was obtained from the EPA document, *Emission Factor Documentation for AP-42 Section 11.12 Concrete Batching, Table 18.5* (June 2006). Similar to PM<sub>10</sub>, it was assumed the process would also include dust controls so the controlled truck loading emission factor was used.

#### Concrete Batch Plant Storage Pile PM10 Emissions

Emission Factor:	1.7	lb PM <sub>10</sub> /acre/day
Assumed Storage Pile Area	0.5	acres/day
Source: BAAQMD Permit Handbook, Section 11.5 Concrete Batch Plants, March 2009		

Table 24A.B-12  
Construction Areas of Disturbance for Fugitive Dust Emissions Calculations

NODOS Disturbed Acres for Fugitive Dust Emission Calculations					
Project Feature (File Name: ProjFacilitiesParcelsAcreages_9-23-11.xls)	Alternative	County	Total Project Feature Acreage (acres)	PM10 Emissions (lbs)	Construction Duration (days)
<b>1.27 MAF Sites Reservoir</b>					
Alt A		Colusa Co	10,491.2	104,911.5	
		Glenn Co	1,600.3	16,002.9	
	<b>Alt A</b>	<b>Total</b>	<b>12,091.4</b>	<b>120,914.4</b>	<b>2224</b>
<b>1.81 MAF Sites Reservoir</b>					
Alts BC		Colusa Co	12,046.1	120,460.8	
		Glenn Co	2,106.1	21,060.7	
	<b>Alts BC</b>	<b>Total</b>	<b>14,152.2</b>	<b>141,521.5</b>	<b>2224</b>
<b>Golden Gates and Sites Dams</b>					
Alt A	<b>Alt A</b>	<b>Total</b>	<b>50.4</b>	<b>504.0</b>	<b>2224</b>
Alts BC	<b>Alts BC</b>	<b>Total</b>	<b>57.7</b>	<b>577.0</b>	<b>2224</b>
<b>6 Saddle Dams</b>					
Alt A		Colusa Co	0.0	-	
		Glenn Co	37.3	372.5	
	<b>Alt A</b>	<b>Total</b>	<b>37.3</b>	<b>372.5</b>	<b>2224</b>
<b>9 Saddle Dams</b>					
Alts BC		Colusa Co	4.2	42.4	
		Glenn Co	94.0	939.7	
	<b>Alts BC</b>	<b>Total</b>	<b>98.2</b>	<b>982.1</b>	<b>2224</b>
<b>Subtotal Sites Reservoir and Dams</b>	<b>Alt A</b>	<b>Total</b>	<b>12179.1</b>	<b>121,790.9</b>	<b>2224</b>
	<b>Alts BC</b>	<b>Total</b>	<b>14308.1</b>	<b>143,080.6</b>	<b>2224</b>
<b>5 Recreation Areas</b>					
Alts ABC		Colusa Co	879.2	8,792.2	
		Glenn Co	329.2	3,292.1	
	<b>Alts ABC</b>	<b>Total</b>	<b>1208.4</b>	<b>12,084.3</b>	<b>731</b>
<b>Road Relocations and South Bridge</b>					
A		Colusa Co	1025.6	10,256.2	
A		Glenn Co	270.3	2,703.3	
	<b>Alt A</b>	<b>Total</b>	<b>1296.0</b>	<b>12,959.5</b>	<b>1403</b>
BC		Colusa Co	1031.4	10,313.8	
BC		Glenn Co	271.6	2,715.8	
	<b>Alts BC</b>	<b>Total</b>	<b>1303.0</b>	<b>13,029.6</b>	<b>1403</b>
<b>Sites Pumping Generating Plant &amp; Electrical Switchyard</b>					
Alts ABC	<b>Alts ABC</b>		<b>5.30</b>	<b>53.0</b>	<b>485</b>
<b>Tunnel from Sites Pum Gen to Intake Outfall</b>					
Alts ABC	<b>Alts ABC</b>		<b>3.1</b>	<b>30.6</b>	<b>485</b>
<b>Sites Res Inlet Outlet Structure</b>					
Alts ABC	<b>Alts ABC</b>		<b>204.2</b>	<b>2,042.2</b>	<b>485</b>
<b>Field Office Maint Yard</b>					
Alts ABC	<b>Alts ABC</b>		<b>18.3</b>	<b>183.4</b>	<b>485</b>
<b>Existing Funks Reservoir Dredging</b>					
Alts ABC	<b>Alts ABC</b>	No PM - WET	<b>228.4</b>	No PM - WET	
<b>Holthouse Reservoir Complex</b>					
Alts ABC	<b>Alts ABC</b>		<b>456.3</b>	<b>4,563.0</b>	<b>826</b>
<b>GCID Canal Intake &amp; Headworks</b>					
<b>&amp; GCID Canal Connection to TRR</b>					
Alts ABC			9.5	95.0	
			3.6	36.0	
	<b>Alts ABC</b>	<b>Total</b>	<b>13.10</b>	<b>131.0</b>	<b>743</b>
<b>TRR</b>	<b>Alts ABC</b>		<b>191.6</b>	<b>1,916.2</b>	<b>487</b>
<b>TRR PG Plant</b>	<b>Alts ABC</b>		<b>0.7</b>	<b>6.5</b>	<b>1276</b>
<b>TRR Easement</b>					
<b>&amp; TRR to Funks Cr Pipeline Easement</b>			386.9	3,868.9	
Alts ABC			20.6	205.6	
	<b>Alts ABC</b>	<b>Total</b>	<b>407.5</b>	<b>4,074.5</b>	<b>549</b>
<b>Delevan Transmission Line</b>					
Alt A	<b>Alt A</b>		<b>372.8</b>	<b>3,727.8</b>	<b>367</b>
Alt B	<b>Alt B (used same values as Alt C)</b>		<b>151.8</b>	<b>1,518.2</b>	<b>367</b>
Alt C	<b>Alt C</b>		<b>372.8</b>	<b>3,727.6</b>	<b>367</b>
<b>Delevan Pipeline Intake Facilities</b>					
<b>&amp; Delevan Pipeline Discharge Facility</b>			19.2	191.5	
Alts ABC			7.7	76.6	
	<b>Alts ABC</b>	<b>Total</b>	<b>26.8</b>	<b>268.1</b>	<b>549</b>
<b>Asphalt Plant</b>					
Alts ABC	<b>Alts ABC</b>		<b>15.0</b>	<b>149.6</b>	<b>100</b>
	<b>Alt A</b>	<b>Total</b>	<b>16,398.1</b>	<b>163,980.6</b>	<b>2224</b>
	<b>Alt B</b>	<b>Total</b>	<b>18,313.1</b>	<b>183,130.8</b>	<b>2224</b>
	<b>Alt C</b>	<b>Total</b>	<b>18,534.0</b>	<b>185,340.2</b>	<b>2224</b>

Table 24A.B-13  
Total GHG Emissions from Construction of Alternatives B and C

**NODOS Total GHG Emissions from Construction of Alternatives B and C**

**Total mtCO<sub>2</sub>e Emissions from Construction Related Activities**

<b>Emissions from Mobile Construction Equipment (From Table 24A. B-5)</b>	<b>Emissions From Concrete Production (See Table Below)</b>	<b>Emissions from Construction Electricity Usage/TBM (See calculations below)</b>	<b>Total Construction Related Emissions</b>
228,475	50,376	4,297	283,148

**Alternatives B and C**

<b>Project Feature</b>	<b>Total Concrete Mass (tons)</b>	<b>Total Concrete (CY)</b>	<b>GHG Emissions (lbs)</b>	<b>GHG Emissions (mt)</b>
Tunnel - Inlet and Outlet Including Sites Pump Plant	77,515	39,751	15,900,513	7,212
Pipelines - Delevan and TRR	11,100	5,692	2,276,923	1,033
Dams & Sites Inundation	85,951	44,077	17,630,974	7,997
TRR Pump Plant	55,500	28,462	11,384,615	5,164
Funks Reservoir Modification	23,773	12,191	4,876,513	2,212
Sacramento River Intake & P/G Plant	55,500	28,462	11,384,615	5,164
Paved Roads & Bridges	186,110	95,441	38,176,410	17,317
GCID Canal & Headworks	21,090	10,815	4,326,154	1,962
Transmission Lines	16,095	8,254	3,301,538	1,498
Recreation	8,780	4,503	1,801,026	817
	541,414	277,648	111,059,282	50,376

**Tunnel Boring Machine Calculations**

TBM will operate for 200 days, 24 hours per day.

About 14 hours per day at max of 6,000 HP = 4476 kw\*14 hrs = 62,664 KWH

About 10 hours per day at 1200 HP = 896 kw\*10 hrs = 8960 KWH

71,624 KWh per day \* 200 days = 14,324,800 KWh total (14,324.8 MWh)

[14,324.8 MWh \\* .300 mtCO<sub>2</sub>e/MWh \(from eGrid 2012 version 1.0 2009 data CAMX subregion Total Output Emissions Rate http://www.epa.gov/cleanenergy/documents/eGRID2012V1\\_0\\_year09\\_SummaryTables.pdf\)](http://www.epa.gov/cleanenergy/documents/eGRID2012V1_0_year09_SummaryTables.pdf)

= 4,297 mtCO<sub>2</sub>e total for TBM use.

## **Emissions from Project Electricity Generation and Use for All Alternatives**

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Table 24A.C-1  
Indirect NOx Emissions from Project Electricity Generation and Use - Emission Calculations

	Net Generation (Long Term) <sup>a</sup>	Units	NOx Emission Factor (lb/MWh) <sup>b</sup>	NOx Emissions (ton/yr)	NOx Emissions (lb/day)
All Facilities (CVP, State Water Project, Proposed NODOS Facilities)					
Existing Conditions	51	GWh/yr	0.42	10.7	58.6
No Action Alternative	-132	GWh/yr	0.42	-27.7	-151.6
No Action Alternative minus Existing Condition	-183	GWh/yr	0.42	-38.4	-210.2
NODOS Alternative A	-499	GWh/yr	0.42	-104.6	-573.1
NODOS Alternative A minus No Action Alternative	-367	GWh/yr	0.42	-76.9	-421.5
NODOS Alternative B	-498	GWh/yr	0.42	-104.4	-571.9
NODOS Alternative B minus No Action Alternative	-366	GWh/yr	0.42	-76.7	-420.3
NODOS Alternative C	-543	GWh/yr	0.42	-113.8	-623.6
NODOS Alternative C minus No Action Alternative	-412	GWh/yr	0.42	-86.4	-473.2
<sup>a</sup> Source: Power and Pumping Cost Reporting Metrics - Summary, NODOS ADEIRS and FS Alternatives, February 8, 2011. Negative values for net electricity generation indicate net electricity use.					
<sup>b</sup> Source for Emission Factor: eGRID2012 Version 1.0, Year 2009 Summary Tables (created April 2012). Summary Table 2, Year 2009 eGRID Subregion Emissions - Criteria Pollutants. Subregion CAMX - WECC California. <a href="http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html">http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html</a>					

Table 24A.C-2  
Indirect NO<sub>x</sub> Emissions from Project Electricity Use for All Alternatives - Summary and Comparison

Table C-2				
Indirect NO <sub>x</sub> Emissions From Project Electricity Use for All Alternatives - Summary and Comparison				
(lb/day)				
Alternative	Project Electricity Net Use [All Facilities (CVP, State Water Project, Proposed NODOS Facilities)] - Long Term (GWh/yr) <sup>a</sup>	Total NO <sub>x</sub> Emissions (lb/day) <sup>b</sup>	Incremental Increase (Compared to Existing Conditions) NO <sub>x</sub> Emissions (lb/day)	Incremental Increase (Compared to No Project/No Action) NO <sub>x</sub> Emissions (lb/day)
Existing Conditions	-51	(58.6)	Not Applicable	Not Applicable
No Project/No Action Alternative	132	151.6	210.2	Not Applicable
Alternative A	499	573.1	631.7	421.5
Alternative B	498	571.9	630.5	420.3
Alternative C	543	623.6	682.2	472.0
<sup>a</sup> Source: Power and Pumping Cost Reporting Metrics - Summary, NODOS ADEIRS and FS Alternatives, February 8, 2011. Negative values for net electricity use indicate net electricity generation.				
<sup>b</sup> Source for Emission Factor: eGRID2012 Version 1.0, Year 2009 Summary Tables (created April 2012). Summary Table 2, Year 2009 eGRID Subregion Emissions - Criteria Pollutants. Subregion CAMX - WECC California. <a href="http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html">http://www.epa.gov/cleanenergy/energy-resources/egrid/index.html</a>				

## **Emissions from Operations and Maintenance of All Alternatives**

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Table 24A.D-1  
Summary of Criteria Pollutant Emissions for Operations and Maintenance of Alternatives

Summary O&M Emissions (lb/day)						
	<b>NOx</b>	<b>PM10</b>	<b>PM2.5</b>	<b>ROG</b>	<b>CO</b>	<b>SOx</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>33</b>	<b>7</b>	<b>7</b>	<b>38</b>	<b>1308</b>	<b>0.1</b>
<b>TCAPCD Threshold (lb/day), Level A</b>	<b>&lt; 25</b>	<b>&lt; 25</b>	<b>-</b>	<b>&lt; 25</b>	<b>-</b>	<b>-</b>
<b>Threshold Exceeded?</b>	<b>Yes, subject to standard mitigation measures</b>	<b>No</b>	<b>-</b>	<b>Yes, subject to standard mitigation measures</b>	<b>-</b>	<b>-</b>
<b>TCAPCD Threshold (lb/day), Level B</b>	<b>&gt; 25</b>	<b>&gt; 25</b>	<b>-</b>	<b>&gt; 25</b>	<b>-</b>	<b>-</b>
<b>Threshold Exceeded?</b>	<b>Yes, incorporate Best Available Mitigation Measures</b>	<b>No</b>	<b>-</b>	<b>Yes, incorporate Best Available Mitigation Measures</b>	<b>-</b>	<b>-</b>
<b>TCAPCD Threshold (lb/day), Level C</b>	<b>&gt; 137</b>	<b>&gt; 137</b>	<b>-</b>	<b>&gt; 137</b>	<b>-</b>	<b>-</b>
<b>Threshold Exceeded?</b>	<b>No</b>	<b>No</b>	<b>-</b>	<b>No</b>	<b>-</b>	<b>-</b>
1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.						
2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.						



Table 24A.D-2  
Operations and Maintenance NOx Emissions

**NODOS Operations and Maintenance (O&M) NOx Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	410	103	4	2
Bobcat	155	155	6	3
Bulldozer	1,400	700	27	13
Dump Truck	522	130	0	5
Excavator	6	0	0	0
Portable Generator	136	136	0	136
Grader	6	6	0	0
4WD Vehicle	2,262	1,635	9	9
Tractor Mower	233	233	4	2
Pump Truck	75	0	0	0
Forklift	159	0	0	0
Front End Loader	85	0	0	0
Air Compressor	22	11	0	0
Water Trucks	77	0	0	0
Flatbed/Boom Truck	251	125	0	0
Portable Welder	71	18	0	18
Scissor Lift	19	6	0	0
ATV (4 WD Vehicle)	179	0	0	0
Motor Boat	1,407	469	0	9
Sedans/Pickups <sup>1</sup>	5	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	30	125	0	0
Crane	0	86	0	0
Boat Operated Dredge	75	313	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	108	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>7,693</b>	<b>4,253</b>	<b>50</b>	<b>197</b>
<b>Duration (days)</b>	<b>365</b>	<b>365</b>	<b>365</b>	<b>365</b>
<b>Average Daily Emissions (lb/day)</b>	<b>21.1</b>	<b>11.7</b>	<b>0.1</b>	<b>0.5</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>33</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	< 25			
<b>Threshold Exceeded?</b>	Yes, subject to standard mitigation measures			
<b>TCAPCD Threshold (lb/day), Level B</b>	> 25			
<b>Threshold Exceeded?</b>	Yes, incorporate Best Available Mitigation Measures			
<b>TCAPCD Threshold (lb/day), Level C</b>	> 137			
<b>Threshold Exceeded?</b>	No			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-3  
Operations and Maintenance PM10 Emissions

**NODOS Operations and Maintenance (O&M) PM10 Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	16	4	0	0
Bobcat	8	8	0	0
Bulldozer	55	27	1	1
Dump Truck	18	5	0	0
Excavator	0	0	0	0
Portable Generator	6	6	0	6
Grader	0	0	0	0
4WD Vehicle	154	112	0	1
Tractor Mower	16	16	0	0
Pump Truck	3	0	0	0
Forklift	6	0	0	0
Front End Loader	5	0	0	0
Air Compressor	1	1	0	0
Water Trucks	3	0	0	0
Flatbed/Boom Truck	9	4	0	0
Portable Welder	3	1	0	1
Scissor Lift	1	0	0	0
ATV (4 WD Vehicle)	12	0	0	0
Motor Boat	1,532	511	0	10
Sedans/Pickups <sup>1</sup>	5	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	1	4	0	0
Crane	0	3	0	0
Boat Operated Dredge	3	11	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	104	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>1,960</b>	<b>713</b>	<b>2</b>	<b>19</b>
<b>Duration (days)</b>	<b>365</b>	<b>365</b>	<b>365</b>	<b>365</b>
<b>Average Daily Emissions (lb/day)</b>	<b>5.4</b>	<b>2.0</b>	<b>0.0</b>	<b>0.1</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>7</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	<b>&lt; 25</b>			
<b>Threshold Exceeded?</b>	<b>No</b>			
<b>TCAPCD Threshold (lb/day), Level B</b>	<b>&gt; 25</b>			
<b>Threshold Exceeded?</b>	<b>No</b>			
<b>TCAPCD Threshold (lb/day), Level C</b>	<b>&gt; 137</b>			
<b>Threshold Exceeded?</b>	<b>No</b>			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-4  
Operations and Maintenance PM2.5 Emissions

**NODOS Operations and Maintenance (O&M) PM2.5 Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	16	4	0	0
Bobcat	8	8	0	0
Bulldozer	55	27	1	1
Dump Truck	18	5	0	0
Excavator	0	0	0	0
Portable Generator	6	6	0	6
Grader	0	0	0	0
4WD Vehicle	154	112	1	1
Tractor Mower	16	16	0	0
Pump Truck	3	0	0	0
Forklift	6	0	0	0
Front End Loader	5	0	0	0
Air Compressor	1	1	0	0
Water Trucks	3	0	0	0
Flatbed/Boom Truck	9	4	0	0
Portable Welder	3	1	0	1
Scissor Lift	1	0	0	0
ATV (4 WD Vehicle)	12	0	0	0
Motor Boat	1,532	511	0	10
Sedans/Pickups <sup>1</sup>	3	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	1	4	0	0
Crane	0	3	0	0
Boat Operated Dredge	3	11	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	50	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>1,904</b>	<b>713</b>	<b>2</b>	<b>19</b>
<b>Duration (days)</b>	<b>365</b>	<b>365</b>	<b>365</b>	<b>365</b>
<b>Average Daily Emissions (lb/day)</b>	<b>5.2</b>	<b>2.0</b>	<b>0.0</b>	<b>0.1</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>7</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level B</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level C</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-5  
Operations and Maintenance ROG Emissions

**NODOS Operations and Maintenance (O&M) ROG Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	66	17	1	0
Bobcat	30	30	1	1
Bulldozer	206	103	4	2
Dump Truck	133	33	0	1
Excavator	1	0	0	0
Portable Generator	15	15	0	15
Grader	1	1	0	0
4WD Vehicle	3,177	2,296	13	13
Tractor Mower	327	327	6	3
Pump Truck	19	0	0	0
Forklift	39	0	0	0
Front End Loader	13	0	0	0
Air Compressor	3	2	0	0
Water Trucks	14	0	0	0
Flatbed/Boom Truck	64	32	0	0
Portable Welder	13	3	0	3
Scissor Lift	3	1	0	0
ATV (4 WD Vehicle)	252	0	0	0
Motor Boat	4,817	1,606	0	31
Sedans/Pickups <sup>1</sup>	2	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	8	32	0	0
Crane	0	15	0	0
Boat Operated Dredge	11	46	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	15	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>9,231</b>	<b>4,559</b>	<b>25</b>	<b>69</b>
<b>Duration (days)</b>	<b>365</b>	<b>365</b>	<b>365</b>	<b>365</b>
<b>Average Daily Emissions (lb/day)</b>	<b>25.3</b>	<b>12.5</b>	<b>0.1</b>	<b>0.2</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>38</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	< 25			
<b>Threshold Exceeded?</b>	Yes, subject to standard mitigation measures			
<b>TCAPCD Threshold (lb/day), Level B</b>	> 25			
<b>Threshold Exceeded?</b>	Yes, incorporate Best Available Mitigation Measures			
<b>TCAPCD Threshold (lb/day), Level C</b>	> 137			
<b>Threshold Exceeded?</b>	No			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-6  
Operations and Maintenance CO Emissions

**NODOS Operations and Maintenance (O&M) CO Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	703	176	7	3
Bobcat	294	294	11	6
Bulldozer	839	419	16	8
Dump Truck	556	139	0	5
Excavator	16	0	0	0
Portable Generator	183	183	0	183
Grader	12	12	0	0
4WD Vehicle	226,689	163,845	898	898
Tractor Mower	23,342	23,342	449	224
Pump Truck	80	0	0	0
Forklift	495	0	0	0
Front End Loader	118	0	0	0
Air Compressor	30	15	0	0
Water Trucks	53	0	0	0
Flatbed/Boom Truck	267	134	0	0
Portable Welder	84	21	0	21
Scissor Lift	20	7	0	0
ATV (4 WD Vehicle)	17,956	0	0	0
Motor Boat	9,306	3,102	0	60
Sedans/Pickups <sup>1</sup>	67	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	32	134	0	0
Crane	0	59	0	0
Boat Operated Dredge	41	169	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	1,398	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>282,582</b>	<b>192,050</b>	<b>1,381</b>	<b>1,409</b>
<b>Duration (days)</b>	<b>365</b>	<b>365</b>	<b>365</b>	<b>365</b>
<b>Average Daily Emissions (lb/day)</b>	<b>774.2</b>	<b>526.2</b>	<b>3.8</b>	<b>3.9</b>
<b>Total Average Daily Emissions (lb/day)</b>	<b>1308</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level B</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level C</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-7  
Operations and Maintenance SOx Emissions

**NODOS Operations and Maintenance (O&M) SOx Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	1	0	0	0
Bobcat	1	1	0	0
Bulldozer	2	1	0	0
Dump Truck	2	1	0	0
Excavator	0	0	0	0
Portable Generator	0	0	0	0
Grader	0	0	0	0
4WD Vehicle	9	6	0	0
Tractor Mower	1	1	0	0
Pump Truck	0	0	0	0
Forklift	1	0	0	0
Front End Loader	0	0	0	0
Air Compressor	0	0	0	0
Water Trucks	0	0	0	0
Flatbed/Boom Truck	1	1	0	0
Portable Welder	0	0	0	0
Scissor Lift	0	0	0	0
ATV (4 WD Vehicle)	1	0	0	0
Motor Boat	3	1	0	0
Sedans/Pickups <sup>1</sup>	1	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	0	1	0	0
Crane	0	0	0	0
Boat Operated Dredge	0	1	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	12	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs)</b>	<b>36</b>	<b>14</b>	<b>0</b>	<b>0</b>
<b>Duration (days)</b>	365	365	365	365
<b>Average Daily Emissions (lb/day)</b>	0.1	0.0	0.0	0.0
<b>Total Average Daily Emissions (lb/day)</b>	<b>0</b>			
<b>TCAPCD Threshold (lb/day), Level A</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level B</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			
<b>TCAPCD Threshold (lb/day), Level C</b>	Not Applicable			
<b>Threshold Exceeded?</b>	Not Applicable			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip.

2. There would be a total of 60 employees supporting work at all sites so the employee commute emissions are represented under the "Reservoirs, Recreation Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-8  
Operations and Maintenance CO<sub>2</sub> Emissions

**NODOS Operations and Maintenance (O&M) CO2 Emissions**

Equipment	Emissions (lbs)			
	Reservoirs, Recreation Facilities, Dams, Roads, Bridges	Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants	Electrical Substations and Transmission Lines	Tunnels, Pipelines, and Canals
Backhoe	59,176	14,794	569	284
Bobcat	25,441	25,441	978	489
Bulldozer	162,523	81,261	3,125	1,563
Dump Truck	161,437	40,359	0	1,552
Excavator	1,535	0	0	0
Portable Generator	19,019	19,019	0	19,019
Grader	1,209	1,209	0	0
4WD Vehicle	358,576	259,169	1,420	1,420
Tractor Mower	36,923	36,923	710	355
Pump Truck	23,284	0	0	0
Forklift	25,224	0	0	0
Front End Loader	9,544	0	0	0
Air Compressor	4,691	2,345	0	0
Water Trucks	25,330	0	0	0
Flatbed/Boom Truck	77,614	38,807	0	0
Portable Welder	4,672	1,168	0	1,168
Scissor Lift	1,353	451	0	0
ATV (4 WD Vehicle)	28,402	0	0	0
Motor Boat	157,898	52,633	0	1,012
Sedans/Pickups <sup>1</sup>	72,341	0	0	0
<b>Longer Term Maintenance</b>				
Dump Truck	9,314	38,807	0	0
Crane	0	12,057	0	0
Boat Operated Dredge	21,009	87,539	0	0
<b>Vehicles</b>				
Employee Commute <sup>2</sup>	1,159,425	-	-	-
<b>Summary</b>				
<b>Total Emissions (lbs/year)</b>	<b>2,445,941</b>	<b>711,983</b>	<b>6,803</b>	<b>26,863</b>
<b>Subtotal Emissions (mt/year)</b>	1109	323	3	12
<b>Total Emissions (mt/year)</b>	<b>1448</b>			

1. It was assumed that sedans/pickups would travel at a speed of 15 mph which equates to 3 roundtrips per hour at a distance of 5 miles per roundtrip. Facilities, Dams, Roads, Bridges" category but this covers all O&M employees.

Table 24A.D-9  
Operations and Maintenance Equipment and Workforce Assumptions

**NODOS**

**Operations and Maintenance Equipment Assumptions**

Equipment	Reservoirs, Recreation Facilities, Dams, Roads, Bridges		Pumping Plants, Intake and Outlet Facilities, Pumping and Generating Plants		Electrical Substations and Transmission Lines		Tunnels, Pipelines, and Canals		TOTAL Estimated Hours/Year of Use per Type of Equipment
	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	Average Number of Piece of Equipment	Estimated Hours/Year of Use per Piece of Equipment	
Backhoe	4	520	1	520	1	20	1	10	2,630
Bobcat	1	520	1	520	1	20	1	10	1,070
Bulldozer	2	520	1	520	1	20	1	10	1,590
Dump Truck	1	1,040	1	260			1	10	1,310
Excavator	1	24							24
Portable Generator	4	100	4	100			4	100	1,200
Grader	1	16	1	16					32
4WD Vehicle	2	5,050	2	3,650	2	20	2	20	17,480
Tractor Mower	2	520	2	520	1	20	1	10	2,110
Pump truck	1	150							150
Fork lift	3	500							1,500
Front End Loader	1	300							300
Air compressor	2	50	1	50					150
Water truck	1	250							250
Flatbed/Boom truck	2	250	1	250					750
Portable welders	2	200	1	100			1	100	600
Scissor lift	1	150	1	50					200
ATV	4	200							800
Motor Boat	2	780	1	520			1	10	2,090
Sedans/Pickup*	4	1,000							4,000
<b>Longer Term Maintenance</b>	One dredge and 1 dump truck for 60 hours every 7 -10 years		One dredge, 1 crane, and 1 dump truck for 250 hours every year						
Dump Truck	1	60	1	250					310
Crane			1	250					250
Boat Operated Dredge	1	60	1	250					310

\*Assume sedans/pickups drive onsite.

**Vehicle Trips**

Vehicle	Total number of round trips	Roundtrip distance (miles)	Average Workforce Required For O & M
Employee Commute	21900	80	60 employees, 10 hr/day (Alts A & C)

Assumes 60 employees per day, 10 hours per day, 365 days per year

Source: DWR 2011.



Table 24A.D-10  
Operations and Maintenance Equipment Emission Factors

**NODOS Operation - Emission Factors**

**O&M Equipment Emission Factors**

Project Equipment Type	Equipment Type from OFFROAD	Load Factor	Horsepower	Emission Factors (g/bhp hr)						
				NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Backhoe	Tractor/Loader/Backhoe	0.55	75	2.168	0.083	312.846	0.351	0.006	3.718	0.083
Bobcat	Other General Industrial	0.51	150	1.772	0.09	290.093	0.342	0.006	3.354	0.09
Bulldozer	Rubber Tired Dozer	0.59	358	2.891	0.113	335.598	0.426	0.005	1.732	0.113
Crane	Crane	0.43	208	1.752	0.061	244.589	0.303	0.006	1.192	0.061
Dump Truck	Off-Highway Truck	0.57	381	1.048	0.037	324.222	0.268	0.005	1.117	0.037
Excavator	Excavator	0.57	157	1.303	0.063	324.222	0.292	0.006	3.36	0.063
Portable Generator	Generator set	0.74	84	2.477	0.117	346.974	0.279	0.006	3.347	0.117
Grader	Grader	0.61	162	1.816	0.093	346.974	0.339	0.006	3.333	0.093
4 WD (ATV)	Rear Engine Riding Mower	0.75	25	5.417	0.37	858.879	7.609	0.021	542.977	0.37
Tractor Mower	Rear Engine Riding Mower	0.75	25	5.417	0.37	858.879	7.609	0.021	542.977	0.37
Pump Truck	Off-Highway Truck	0.57	381	1.048	0.037	324.222	0.268	0.005	1.117	0.037
Forklift	Forklift	0.30	149	1.075	0.04	170.643	0.261	0.006	3.346	0.04
Front End Loader	Rubber Tired Loader	0.54	87	2.725	0.148	307.158	0.432	0.006	3.794	0.148
Air Compressor	Air Compressor	0.48	78	2.631	0.143	568.299	0.387	0.006	3.657	0.143
Water Trucks	Water Truck	0.75	189	0.982	0.034	324.222	0.181	0.004	0.684	0.034
Flatbed/Boom Truck	Off-Highway Truck	0.57	381	1.048	0.037	324.222	0.268	0.005	1.117	0.037
Portable Welder	Welder	0.45	46	3.891	0.151	255.965	0.697	0.007	4.596	0.151
Scissor Lift	Aerial Lift	0.46	34	3.72	0.129	261.653	0.552	0.007	3.955	0.129
Project Equipment Type	Equipment Type from OFFROAD	Emission Factors (lb/hr)							CO	PM2.5
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5		
Motor Boat	Vessel with Outboard Engine	0.902	0.982	101.216	3.088	0.002	5.965	0.982		
Boat Operated Dredge	Dredger									
		1.254	0.045	350.157	0.184	0.003	0.676	0.045		

1. Load factors, horsepower, and emission factors from the CalEEMod User's Guide, Appendix D (Environ, 2011). The CO2 emission factors are from Appendix I of the URBEMIS2007 for Windows.
2. The emission factors are for the year 2023.
3. It was assumed emissions from pump trucks and dump trucks would be represented using the Off-highway truck emission factors. These trucks would primarily travel within the project area.
4. Emission factors for the motor boat and boat operated dredge were obtained from the OFFROAD2007 model.

**Vehicle Emission Factors**

Vehicle	Vehicle Type in EMFAC2007	Emission Factors (lb/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.0001	0.0001	1.2057	0.0000	0.0000	0.0011	0.0000
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.0001	0.0001	0.6618	0.0000	0.0000	0.0008	0.0000
Truck at 15 mph	Heavy-Heavy Duty Diesel	0.0072	0.0003	5.7230	0.0012	0.0001	0.0031	0.0002
Truck at 35 mph	Heavy-Heavy Duty Diesel	0.0044	0.0003	4.0296	0.0005	0.0000	0.0019	0.0002
Vehicle	Vehicle Type in EMFAC2007	Emission Factors (g/mile)						
		NOx	PM10	CO2	ROG	SOx	CO	PM2.5
Personnel at 15 mph	Passenger Vehicles, Gasoline	0.038	0.037	546.900	0.012	0.005	0.505	0.022
Personnel at 35 mph	Passenger Vehicles, Gasoline	0.028	0.027	300.180	0.004	0.003	0.362	0.013
Truck at 15 mph	Heavy-Heavy Duty Diesel	3.288	0.127	2595.958	0.538	0.025	1.403	0.079
Truck at 35 mph	Heavy-Heavy Duty Diesel	1.999	0.124	1827.808	0.21	0.017	0.881	0.076

1. It was assumed that 'non-personnel' trips are diesel truck trips.
2. Emission factors from the California Air Resources Board's EMFAC 2007 model for the Colusa County portion of the Sacramento Valley Air Basin. It was assumed that diesel trucks would be ten years old or newer so the model year in EMFAC was changed to 2013 through 2023, rather than the default of 1979- 2023.
3. Truck age assumption based on the ARB *Staff Assessment of the Impact of the Economy on California Trucking Activity and Emissions 2006-2014*, December 2009.
4. It was assumed that vehicles would travel at an average speed of 35 mph offsite and 15 mph on unpaved roads.
5. The PM10 and PM2.5 emission factors include tire and brake wear.

**Calculation of Paved Road Emission Factor**

Paved Roads emission factor from AP-42, Section 13.2.1: *Paved Roads* (1/11)

$$E = [k(sL)^{0.91} \cdot (W)^{1.02}]$$

where:

k =	1.0	particle size multiplier, g/VMT [Table 13.2-1.1]
sL =	0.03	road surface silt loading (g/m <sup>2</sup> ) [Table 13.2-1-2]
W =	2.2	vehicle weight [tons, from CalEEMOD CalEEMod User's Guide, Appendix A (Environ, 2011)]
E (PM10) =	0.092	g/VMT

**Calculation of Unpaved Road Emission Factor**

**PM10**

Emission Factor [lb/mi] = 1.5 x (silt content [%] / 12)<sup>0.9</sup> x (average vehicle weight [tons] / 3)<sup>0.45</sup> x (365-P)/365

Reference: AP-42, Section 13.2.2, November 2006

Parameter	Value
Average Vehicle Weight (tons)	8
Silt Content (%)	4.3
P, Number of days with Precip >0.01 inches	50
Emission Factor (lb/mile)	0.45

Reference for Silt Content: AP-42, Section 13.2.2, Table 13.2.2-1, Average for a Service Road  
Reference for Precipitation: WRCC, Hollister CA, <http://www.wrcc.dri.edu/cgi-bin/cliGCSIP.pl?ca4025>  
The emission factor accounts for a 44% reduction assuming truck speeds are limited to 15 mph or less.

**Disturbed Land Fugitive Dust Emission Factor**

Emission Factor (lb/acre/day) 10  
From URBEMIS2007 construction phase mass site grading, for average conditions.